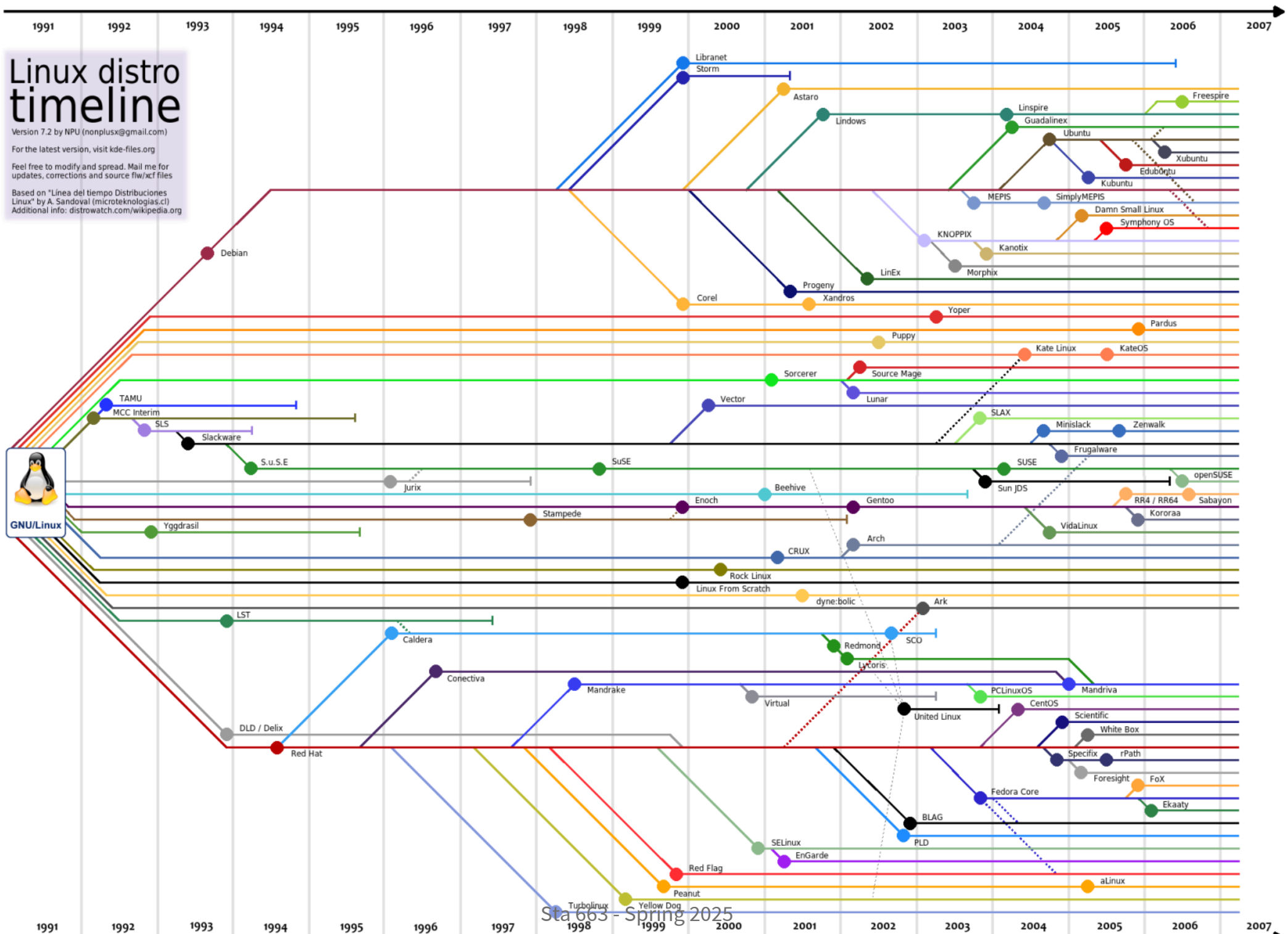
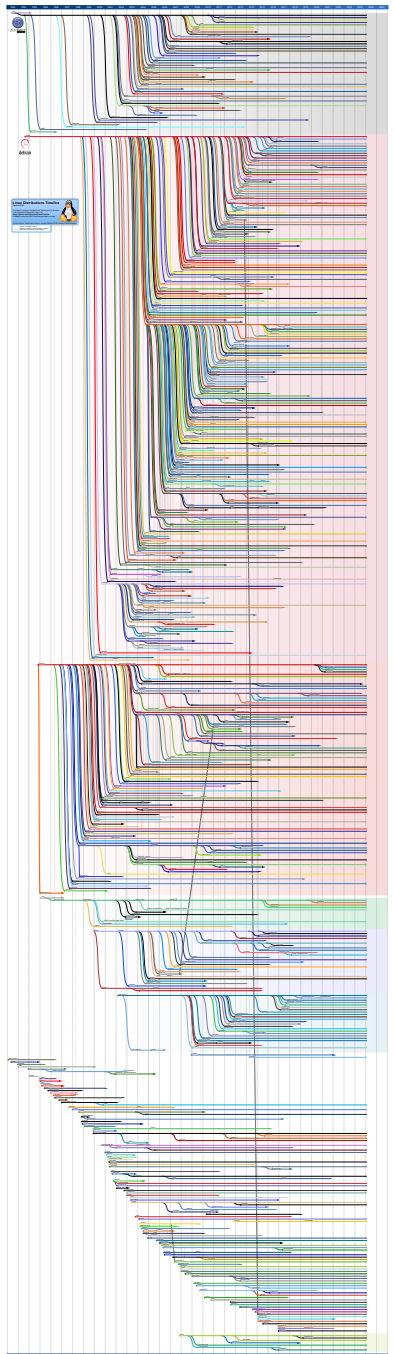
Basic linux & Docker

Lecture 20

Dr. Colin Rundel


Linux distro timeline
Version 7.2 by NPU (nonplusx@gmail.com)
For the latest version, visit kde-files.org
Feel free to modify and spread. Mail me for updates, corrections and source flw/xcf files
Based on "Línea del tiempo Distribuciones Linux" by A. Sandoval (microteknologias.cl)
Additional info: distrowatch.com/wikipedia.org
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
GNU/Linux
Debian
TAMU
MCC Interim
SLS
Slackware
S.u.S.E
Jurix
Yggdrasil
LST
DLD / Delix
Red Hat
Caldera
Conectiva
Turbolinux
Yellow Dog
Peanut
Red Flag
SELinux
EnGarde
Mandrake
Virtual
Corel
Libranet
Storm
Astaro
Lindows
Progeny
Xandros
LinEx
Vector
Sorcerer
Stampede
SuSE
Enoch
Beehive
Gentoo
Yoper
Puppy
Source Mage
Lunar
CRUX
Rock Linux
Linux From Scratch
dyne:bolic
Arch
Pardus
Kate Linux
KateOS
SLAX
Minislack
Zenwalk
Frugalware
SUSE
Sun JDS
openSUSE
RR4 / RR64
Sabayon
Kororaa
VidaLinux
Linspire
Guadalinex
Ubuntu
Xubuntu
Edubuntu
Kubuntu
MEPIS
SimplyMEPIS
Damn Small Linux
Symphony OS
KNOPPIX
Kanotix
Morphix
Ark
SCO
Redmond
Lycoris
Mandriva
PCLinuxOS
CentOS
United Linux
Scientific
White Box
Specifix
rPath
Foresight
FoX
Ekaaty
Fedora Core
BLAG
PLD
aLinux
Freespire



Duke VCM

Welcome to Virtual Computing Manager!

Virtual Computing Manager is a service providing the Duke community with easy access to virtual software packages, and semester-long virtual machine (VM) reservations. Access specialized software without installing it on your own computer, host your own server for development projects and coursework, or customize your own environment to use for the semester.

My Reservations

No reserved resources for the current semester

Virtual Machines (aka VMs)

Your Duke VM is like having a second computer that lives in OIT. You can log into and use your VM from your own machine.

- Run Windows or Linux
- Install zero, one or multiple apps for free

Reserve a VM

Virtual Software (aka Containers)

A Container lets you use a desktop software application in your browser without installing it on your machine or your VM.

- Simple to use
- Launch an app in a click!
- Use anywhere you can run a browser

Reserve a Container

Not sure what you need? Check out the Help page or contact vm-manager-help@duke.edu for assistance

vcm.duke.edu

Most Popular

Windows 10

Windows 10 operating system

Ubuntu Server 20.04

Ubuntu Server 20.04 LTS (Focal Fossa)

Fuqua Office 2019 64-Bit

Microsoft Office 2019 Professional Plus 64-bit: Word 2019, Excel 2019, PowerPoint 2019, Outlook, OneNote (2016), Publisher and Access.

Course

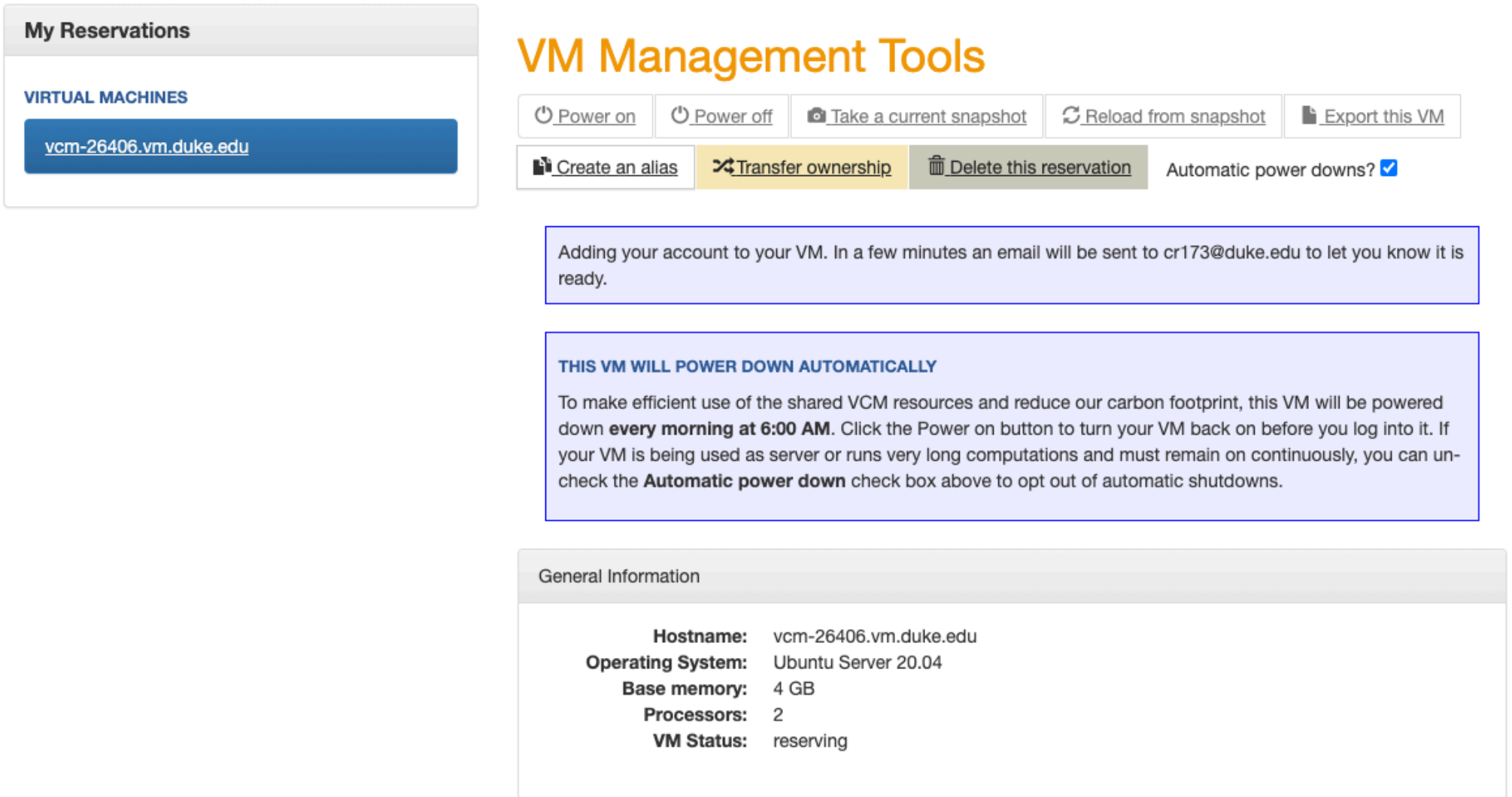
COMPSCI 390

Ubuntu 20.04 Mate desktop with Chrome, Java and Ghidra

Everything

All | Linux | Windows

- CentOS Stream 8
- COMPSCI 390 Ubuntu 20.04 Mate desktop with Chrome, Java and Ghidra
- Generic CentOS 7 The CentOS Linux distribution is community-driven free software derived from the sources of Red Hat Enterprise Linux (RHEL).
- Lamp Stack Linux, Apache, MySQL, PHP development environment
- Linux Matlab MATLAB R2021a numerical computation, visualization, & programming for Linux
- Ubuntu Server 20.04 Ubuntu Server 20.04 LTS (Focal Fossa)
- Ubuntu Server 22.04 Ubuntu Server 22.04 (Jammy Jellyfish)


My Reservations
VIRTUAL MACHINES
vcm-26406.vm.duke.edu
VM Management Tools
Power on
Power off
Take a current snapshot
Reload from snapshot
Export this VM
Create an alias
Transfer ownership
Delete this reservation
Automatic power downs?
Adding your account to your VM. In a few minutes an email will be sent to cr173@duke.edu to let you know it is ready.
THIS VM WILL POWER DOWN AUTOMATICALLY
To make efficient use of the shared VCM resources and reduce our carbon footprint, this VM will be powered down every morning at 6:00 AM. Click the Power on button to turn your VM back on before you log into it. If your VM is being used as server or runs very long computations and must remain on continuously, you can un-check the Automatic power down check box above to opt out of automatic shutdowns.
General Information
Hostname: vcm-26406.vm.duke.edu
Operating System: Ubuntu Server 20.04
Base memory: 4 GB
Processors: 2
VM Status: reserving

Getting Started

Connecting

```
1 rundel@tbBook [~]$ ssh cr173@vcm-47003.vm.duke.edu
```

```
The authenticity of host 'vcm-47003.vm.duke.edu (67.159.69.176)' can't be established.
ED25519 key fingerprint is SHA256:fSZfURPpnL4M+0bWv6S3jMYtalAeKZWSLH6DR+sxOe0.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])?

Warning: Permanently added 'vcm-47003.vm.duke.edu' (ED25519) to the list of known hosts.
cr173@vcm-47003.vm.duke.edu's password:

Welcome to Ubuntu 24.04.2 LTS (GNU/Linux 6.8.0-56-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Thu Mar 27 10:11:09 AM EDT 2025

  System load:    0.55              Processes:             193
  Usage of /home: 2.1% of 17.93GB   Users logged in:       0
  Memory usage:   18%               IPv4 address for eth0: 67.159.69.176
  Swap usage:     0%

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
   just raised the bar for easy, resilient and secure K8s cluster deployment.

   https://ubuntu.com/engage/secure-kubernetes-at-the-edge
```

Determining Distribution

Ubuntu / Debian | Fedora / RHEL

```
cr173@vcm-47003:~$ cat /etc/os-release
```

```
PRETTY_NAME="Ubuntu 24.04.2 LTS"
NAME="Ubuntu"
VERSION_ID="24.04"
VERSION="24.04.2 LTS (Noble Numbat)"
VERSION_CODENAME=noble
ID=ubuntu
ID_LIKE=debian
HOME_URL="https://www.ubuntu.com/"
SUPPORT_URL="https://help.ubuntu.com/"
BUG_REPORT_URL="https://bugs.launchpad.net/ubuntu/"
PRIVACY_POLICY_URL="https://www.ubuntu.com/legal/terms-and-policies/privacy-policy"
UBUNTU_CODENAME=noble
LOGO=ubuntu-logo
```

System Details

Filesystem Hierarchy Standard

Primary | Secondary

```
1 cr173@vcm-47003:~$ tree -d -L 1 /
```

```
/
├── bin -> usr/bin
├── bin.usr-is-merged
├── boot
├── cdrom
├── dev
├── etc
├── home
├── lib -> usr/lib
├── lib64 -> usr/lib64
├── lib.usr-is-merged
├── media
├── mnt
├── opt
├── proc
├── root
├── run
├── sbin -> usr/sbin
```

Some common folders:

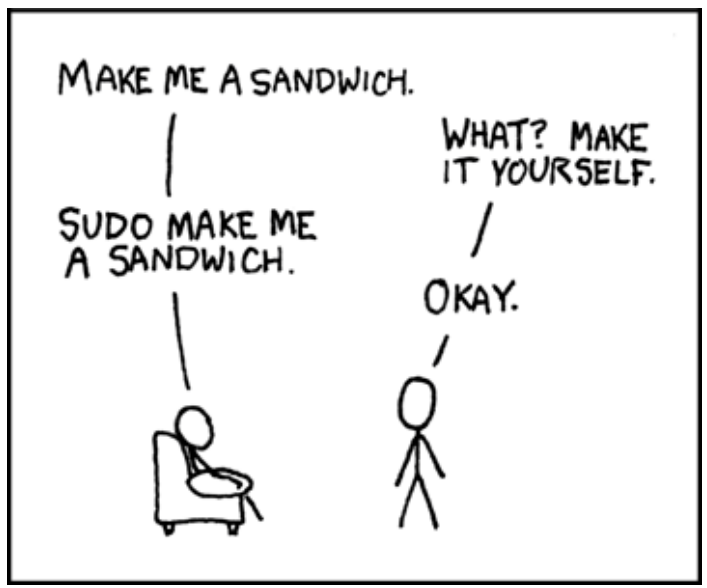
- `/bin/` & `/usr/bin/` - executeables
- `/etc/` - configuration files
- `/lib*/` & `/usr/lib*/` - Static and shared libraries
- `/usr/include/` - header files
- `/home/` - home directories
- `/var/` - logs
- `/tmp/` - temporary files

Installing packages with `apt` (Ubuntu, Debian, etc.)

Update the package list

```
1 cr173@vcm-47003:~$ apt update
```

```
Reading package lists... Done
E: Could not open lock file /var/lib/apt/lists/lock - open (13: Permission denied)
E: Unable to lock directory /var/lib/apt/lists/
W: Problem unlinking the file /var/cache/apt/pkgcache.bin - RemoveCaches (13: Permission denied)
W: Problem unlinking the file /var/cache/apt/srcpkgcache.bin - RemoveCaches (13: Permission denied
```



XKCD 149 - Sandwich

Update the package list

```
cr173@vcm-47003:~$ sudo apt update
```

```
[sudo] password for cr173:
Hit:1 http://archive.linux.duke.edu/ubuntu focal InRelease
Get:2 http://archive.linux.duke.edu/ubuntu focal-updates InRelease [114 kB]
Hit:3 https://falcon-dl.oit.duke.edu/ubuntu focal InRelease
Get:4 http://archive.linux.duke.edu/ubuntu focal-backports InRelease [108 kB]
Get:5 http://archive.linux.duke.edu/ubuntu focal-security InRelease [114 kB]
Get:6 http://archive.linux.duke.edu/ubuntu focal-updates/main amd64 Packages [1,711 kB]
Get:7 http://archive.linux.duke.edu/ubuntu focal-updates/main i386 Packages [628 kB]
Get:8 http://archive.linux.duke.edu/ubuntu focal-updates/main Translation-en [320 kB]
Get:9 http://archive.linux.duke.edu/ubuntu focal-updates/restricted amd64 Packages [917 kB]
Get:10 http://archive.linux.duke.edu/ubuntu focal-updates/restricted Translation-en [131 kB]
Get:11 http://archive.linux.duke.edu/ubuntu focal-updates/universe amd64 Packages [916 kB]
Get:12 http://archive.linux.duke.edu/ubuntu focal-updates/universe i386 Packages [676 kB]
Get:13 http://archive.linux.duke.edu/ubuntu focal-updates/universe Translation-en [204 kB]
Get:14 http://archive.linux.duke.edu/ubuntu focal-updates/universe amd64 c-n-f Metadata [20.4 kB]
Get:15 http://archive.linux.duke.edu/ubuntu focal-security/main i386 Packages [416 kB]
Get:16 http://archive.linux.duke.edu/ubuntu focal-security/main amd64 Packages [1,383 kB]
Get:17 http://archive.linux.duke.edu/ubuntu focal-security/main Translation-en [239 kB]
```

Installing R

```
cr173@vcm-47003:~$ sudo apt install r-base
```

```
[sudo] password for cr173:

Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  build-essential bzip2-doc cpp cpp-9 dpkg-dev fakeroot fontconfig fontconfig-config fonts-dejavu-
  libalgorithm-diff-perl libalgorithm-diff-xs-perl libalgorithm-merge-perl libasan5 libatomic1 lib
  libdata-dump-perl libdatrie1 libdpkg-perl libdrm-amdgpu1 libdrm-intel1 libdrm-nouveau2 libdrm-ra
  libfile-desktopentry-perl libfile-fcntllock-perl libfile-listing-perl libfile-mimeinfo-perl libf
  libgfortran5 libgl1 libgl1-mesa-dri libglapi-mesa libglvnd0 libglx-mesa0 libglx0 libgomp1 libgra
  libhtml-parser-perl libhtml-tagset-perl libhtml-tree-perl libhttp-cookies-perl libhttp-daemon-pe
  libicu-dev libio-html-perl libio-socket-ssl-perl libio-stringy-perl libipc-system-simple-perl li
  libjpeg8-dev liblapack-dev liblapack3 libllvm12 liblsan0 liblwp-mediatypes-perl liblwp-protocol-
  libncurses5-dev libnet-dbus-perl libnet-http-perl libnet-smtp-ssl-perl libnet-ssleay-perl libpar
  libpciaccess0 libpcre16-3 libpcre2-16-0 libpcre2-32-0 libpcre2-dev libpcre2-posix2 libpcre3-dev
  libreadline-dev libsensors-config libsensors5 libsm6 libstdc++-9-dev libtcl8.6 libthai-data libt
  libtsan0 libubsan1 liburi-perl libvulkan1 libwayland-client0 libwebp6 libwww-perl libwww-robotru
  libxcb-glx0 libxcb-present0 libxcb-randr0 libxcb-render0 libxcb-shape0 libxcb-shm0 libxcb-sync1
  libxinerama1 libxkbfile1 libxml-parser-perl libxml-twig-perl libxml-xpathengine-perl libxmu6 lib
```

Removing R

```
cr173@vcm-47003:~$ sudo apt remove r-base
```

```
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  fontconfig fontconfig-config fonts-dejavu-core gfortran gfortran-9 icu-devtools libblas-dev libb
  libdrm-nouveau2 libdrm-radeon1 libfile-basedir-perl libfile-desktopentry-perl libfile-mimeinfo-p
  libgl1-mesa-dri libglapi-mesa libglvnd0 libglx-mesa0 libglx0 libgraphite2-3 libharfbuzz0b libice
  libjpeg-turbo8 libjpeg-turbo8-dev libjpeg8 libjpeg8-dev liblapack-dev liblapack3 libllvm12 liblz
  libpangocairo-1.0-0 libpangoft2-1.0-0 libpaper-utils libpaper1 libpciaccess0 libpcre16-3 libpcre
  libpcrecpp0v5 libpixman-1-0 libpng-dev libpng-tools libreadline-dev libsensors-config libsensors
  libvulkan1 libwayland-client0 libwebp6 libx11-protocol-perl libx11-xcb1 libxaw7 libxcb-dri2-0 li
  libxcb-shape0 libxcb-shm0 libxcb-sync1 libxcb-xfixes0 libxcomposite1 libxcursor1 libxfixes3 libx
  libxml-xpathengine-perl libxmu6 libxpm4 libxrandr2 libxrender1 libxshmfence1 libxss1 libxt6 libx
  r-base-dev r-base-html r-cran-boot r-cran-class r-cran-cluster r-cran-codetools r-cran-foreign r
  r-cran-nlme r-cran-nnet r-cran-rpart r-cran-spatial r-cran-survival r-doc-html r-recommended unz
Use 'sudo apt autoremove' to remove them.
The following packages will be REMOVED:
  r-base
```

and all of its dependencies

```
1 cr173@vcm-47003:~$ sudo apt autoremove
```

```
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages will be REMOVED:
  fontconfig fontconfig-config fonts-dejavu-core gfortran gfortran-9 icu-devtools libblas-dev libb
  libdrm-nouveau2 libdrm-radeon1 libfile-basedir-perl libfile-desktopentry-perl libfile-mimeinfo-p
  libgl1-mesa-dri libglapi-mesa libglvnd0 libglx-mesa0 libglx0 libgraphite2-3 libharfbuzz0b libice
  libjpeg-turbo8 libjpeg-turbo8-dev libjpeg8 libjpeg8-dev liblapack-dev liblapack3 libllvm12 liblz
  libpangocairo-1.0-0 libpangoft2-1.0-0 libpaper-utils libpaper1 libpciaccess0 libpcre16-3 libpcre
  libpcrecpp0v5 libpixman-1-0 libpng-dev libpng-tools libreadline-dev libsensors-config libsensors
  libvulkan1 libwayland-client0 libwebp6 libx11-protocol-perl libx11-xcb1 libxaw7 libxcb-dri2-0 li
  libxcb-shape0 libxcb-shm0 libxcb-sync1 libxcb-xfixes0 libxcomposite1 libxcursor1 libxfixes3 libx
  libxml-xpathengine-perl libxmu6 libxpm4 libxrandr2 libxrender1 libxshmfence1 libxss1 libxt6 libx
  r-base-dev r-base-html r-cran-boot r-cran-class r-cran-cluster r-cran-codetools r-cran-foreign r
  r-cran-nlme r-cran-nnet r-cran-rpart r-cran-spatial r-cran-survival r-doc-html r-recommended unz
0 upgraded, 0 newly installed, 140 to remove and 1 not upgraded.
After this operation, 749 MB disk space will be freed.
Do you want to continue? [Y/n]
```

Updating & Upgrading

```
cr173@vcm-47003:~$ sudo apt update
```

```
Hit:1 http://archive.linux.duke.edu/ubuntu focal InRelease
Hit:2 http://archive.linux.duke.edu/ubuntu focal-updates InRelease
Hit:3 http://archive.linux.duke.edu/ubuntu focal-backports InRelease
Hit:4 http://archive.linux.duke.edu/ubuntu focal-security InRelease
Hit:5 https://falcon-dl.oit.duke.edu/ubuntu focal InRelease
Reading package lists... Done
Building dependency tree
Reading state information... Done
1 package can be upgraded. Run 'apt list --upgradable' to see it.
```

```
cr173@vcm-47003:~$ sudo apt upgrade
```

```
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
The following packages will be upgraded:
  libfribidi0
1 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
1 standard security update
Need to get 24.2 kB of archives.
After this operation, 0 B of additional disk space will be used.
Do you want to continue? [Y/n]
```

Aside - Conflicts

```
...
update-initramfs: deferring update (trigger activated)
amd64-microcode: microcode will be updated at next boot
Setting up intel-microcode (3.20180807a.0ubuntu0.18.04.1) ...
update-initramfs: deferring update (trigger activated)
intel-microcode: microcode will be updated at next boot
Setting up kmod (24-1ubuntu3.1) ...

*Configuration file '/etc/modprobe.d/blacklist.conf'
* ==> Modified (by you or by a script) since installation.
* ==> Package distributor has shipped an updated version.
*   What would you like to do about it ?  Your options are:
*    Y or I  : install the package maintainer's version
*    N or O  : keep your currently-installed version
*      D     : show the differences between the versions
*      Z     : start a shell to examine the situation
* The default action is to keep your current version.
**** blacklist.conf (Y/I/N/O/D/Z) [default=N] ?
Setting up initramfs-tools-core (0.130ubuntu3.6) ...
Setting up linux-headers-4.15.0-43-generic (4.15.0-43.46) ...
Setting up initramfs-tools (0.130ubuntu3.6) ...

...
```

Package Details

```
1 cr173@vcm-47003:~$ apt show r-base
```

```
Package: r-base
Version: 3.6.3-2
Priority: optional
Section: universe/math
Origin: Ubuntu
Maintainer: Ubuntu Developers <ubuntu-devel-discuss@lists.ubuntu.com>
Original-Maintainer: Dirk Eddelbuettel <edd@debian.org>
Bugs: https://bugs.launchpad.net/ubuntu/+filebug
Installed-Size: 62.5 kB
Depends: r-base-core (>= 3.6.3-2), r-recommended (= 3.6.3-2)
Recommends: r-base-html, r-doc-html
Suggests: elpa-ess, r-doc-info | r-doc-pdf
Homepage: http://www.r-project.org/
Download-Size: 9,308 B
APT-Manual-Installed: yes
APT-Sources: http://archive.linux.duke.edu/ubuntu focal/universe amd64 Packages
Description: GNU R statistical computation and graphics system
 R is a system for statistical computation and graphics. It consists
```

Package Contents

To list the files installed by a package,

```
1  cr173@vcm-47003:~$ dpkg -L r-base
```

```
/.
/usr
/usr/share
/usr/share/doc
/usr/share/doc/r-base
/usr/share/doc/r-base/README.Debian
/usr/share/doc/r-base/copyright
/usr/share/doc/r-base/changelog.Debian.gz
```

or if you want to find which package created a file,

```
1  cr173@vcm-47003:~$ dpkg -S /usr/bin/R
```

```
r-base-core: /usr/bin/R
```

Package Manager Comparison

	Ubuntu / Debian	RHEL	Fedora	Requires root
Install	`apt install`	`yum install`	`dnf install`	Yes
Install Local	`dpkg -i pkg.deb`	`yum install pkg.rpm`	`dnf install pkg.rpm`	Yes
Remove	`apt remove`	`yum remove`	`dnf remove`	Yes
Update	`apt update`	`yum check-update`	`dnf check-update`	Yes
Upgrade	`apt upgrade` `apt full-upgrade`	`yum upgrade`	`dnf upgrade`	Yes
Clean Deps.	`apt autoremove`	`yum autoremove`	`dnf autoremove`	Yes
Reinstall	`apt install --reinstall`	`yum reinstall`	`dnf reinstall`	Yes
Details.	`apt show`	`yum info`	`dnf info`	No
Dependencies	`apt show`	`yum deplist`	`dnf repoquery --requires`	No
Pkg -> Files	`dpkg -L`	`rpm -qf`	`rpm -qf`	No
Files -> Pkg	`dpkg -S`	`rpm -ql`	`rpm -ql` or `dnf repoquery -l`	No

A bit about libraries

System libraries

These are shared common components that are used by a variety of software on a linux system. For the most part they are a collection of compiled code (typically C / C++) that are stored in a single file.

- Allows for code reuse
- Allows for multiple (concurrent) versions
- Avoids reinventing the wheel
- Installed in `/lib`, `/usr/lib`, `/usr/local/lib`, etc.
- Two flavors: static (`.a`) and dynamic / shared (`.so`)

libcurl

```
1  cr173@vcm-47003:~$ ls -la /usr/lib/x86_64-linux-gnu/libcurl*
```

```
-rw-r--r-- 1 root root 1057632 Oct 29 08:10 /usr/lib/x86_64-linux-gnu/libcurl.a
lrwxrwxrwx 1 root root      19 Oct 29 08:10 /usr/lib/x86_64-linux-gnu/libcurl-gnutls.so.3 -> libcu
lrwxrwxrwx 1 root root      23 Oct 29 08:10 /usr/lib/x86_64-linux-gnu/libcurl-gnutls.so.4 -> libcu
-rw-r--r-- 1 root root  510408 Oct 29 08:10 /usr/lib/x86_64-linux-gnu/libcurl-gnutls.so.4.5.0
-rw-r--r-- 1 root root     951 Oct 29 08:10 /usr/lib/x86_64-linux-gnu/libcurl.la
lrwxrwxrwx 1 root root      16 Oct 29 08:10 /usr/lib/x86_64-linux-gnu/libcurl.so -> libcurl.so.4.5
lrwxrwxrwx 1 root root      16 Oct 29 08:10 /usr/lib/x86_64-linux-gnu/libcurl.so.4 -> libcurl.so.4
-rw-r--r-- 1 root root  518600 Oct 29 08:10 /usr/lib/x86_64-linux-gnu/libcurl.so.4.5.0
```

Getting what you want

The following is a basic heuristic of library package naming schemes for the two primary distro families, there are exceptions and edge cases.

These are the names that would then be used with something like `apt install` or `yum install` respectively.

	Debian	Redhat
Dynamic library (.so)	`lib{name}`	`{name}`
Headers	`lib{name}-dev`	`{name}-devel`
Static library (.a)	`lib{name}-dev`	`{name}-static`
Documentation	`lib{name}-doc`	`{name}-devel`

Troubleshooting dynamic libraries

```
1 cr173@vcm-47003:~$ ldd /usr/lib/x86_64-linux-gnu/libcurl.so
```

```
linux-vdso.so.1 (0x00007ffd98176000)
libnghttp2.so.14 => /usr/lib/x86_64-linux-gnu/libnghttp2.so.14 (0x00007f1e3dc60000)
libidn2.so.0 => /usr/lib/x86_64-linux-gnu/libidn2.so.0 (0x00007f1e3da43000)
librtmp.so.1 => /usr/lib/x86_64-linux-gnu/librtmp.so.1 (0x00007f1e3d827000)
libpsl.so.5 => /usr/lib/x86_64-linux-gnu/libpsl.so.5 (0x00007f1e3d619000)
libssl.so.1.1 => /usr/lib/x86_64-linux-gnu/libssl.so.1.1 (0x00007f1e3d3af000)
libcrypto.so.1.1 => /usr/lib/x86_64-linux-gnu/libcrypto.so.1.1 (0x00007f1e3cf37000)
libgssapi_krb5.so.2 => /usr/lib/x86_64-linux-gnu/libgssapi_krb5.so.2 (0x00007f1e3ccec000)
libldap_r-2.4.so.2 => /usr/lib/x86_64-linux-gnu/libldap_r-2.4.so.2 (0x00007f1e3ca9a000)
liblber-2.4.so.2 => /usr/lib/x86_64-linux-gnu/liblber-2.4.so.2 (0x00007f1e3c88c000)
libz.so.1 => /lib/x86_64-linux-gnu/libz.so.1 (0x00007f1e3c66f000)
libpthread.so.0 => /lib/x86_64-linux-gnu/libpthread.so.0 (0x00007f1e3c450000)
libc.so.6 => /lib/x86_64-linux-gnu/libc.so.6 (0x00007f1e3c05f000)
libunistring.so.2 => /usr/lib/x86_64-linux-gnu/libunistring.so.2 (0x00007f1e3bce1000)
libgnutls.so.30 => /usr/lib/x86_64-linux-gnu/libgnutls.so.30 (0x00007f1e3b97c000)
libhogweed.so.4 => /usr/lib/x86_64-linux-gnu/libhogweed.so.4 (0x00007f1e3b748000)
libnettle.so.6 => /usr/lib/x86_64-linux-gnu/libnettle.so.6 (0x00007f1e3b512000)
libgmp.so.10 => /usr/lib/x86_64-linux-gnu/libgmp.so.10 (0x00007f1e3b291000)
```

Python management

```
1 cr173@vcm-47003:~$ pip install torch
```

```
Command 'pip' not found, but can be installed with:

apt install python3-pip
Please ask your administrator.
```

```
1 cr173@vcm-47003:~$ sudo apt install python3-pip
```

```
[sudo] password for cr173:

Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  build-essential bzip2 cpp cpp-13 cpp-13-x86-64-linux-gnu cpp-x86-64-linux-gnu dpkg-dev fakeroot
  gcc-13-x86-64-linux-gnu gcc-x86-64-linux-gnu javascript-common libalgorithm-diff-perl libalgorit
  libexpat1-dev libfakeroot libfile-fcntllock-perl libgcc-13-dev libgomp1 libhwasan0 libisl23 libi
  libpython3.12-dev libquadmath0 libstdc++-13-dev libtsan2 libubsan1 lto-disabled-list make python
Suggested packages:
  bzip2-doc cpp-doc gcc-13-locales cpp-13-doc debian-keyring g++-multilib g++-13-multilib gcc-13-d
  gdb-x86-64-linux-gnu apache2 | lighttpd | httpd bzr libstdc++-13-doc make-doc
The following NEW packages will be installed:
  build-essential bzip2 cpp cpp-13 cpp-13-x86-64-linux-gnu cpp-x86-64-linux-gnu dpkg-dev fakeroot
  gcc-13-x86-64-linux-gnu gcc-x86-64-linux-gnu javascript-common libalgorithm-diff-perl libalgorit
  libexpat1-dev libfakeroot libfile-fcntllock-perl libgcc-13-dev libgomp1 libhwasan0 libisl23 libi
  libpython3.12-dev libquadmath0 libstdc++-13-dev libtsan2 libubsan1 lto-disabled-list make python
0 upgraded, 51 newly installed, 0 to remove and 0 not upgraded.
Need to get 72.6 MB of archives.
```

Package manager vs pip

```
1 cr173@vcm-47003:~$ sudo apt install python3-numpy
```

```
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libblas3 libgfortran5 liblapack3
Suggested packages:
  gfortran python3-pytest
The following NEW packages will be installed:
  libblas3 libgfortran5 liblapack3 python3-numpy
0 upgraded, 4 newly installed, 0 to remove and 0 not upgraded.
Need to get 8,238 kB of archives.
After this operation, 35.2 MB of additional disk space will be used.
Do you want to continue? [Y/n]
```

pip install & PEP 668

pip | force

```
1 cr173@vcm-47003:~$ sudo pip install numpy --upgrade
```

```
sudo pip install numpy --upgrade
error: externally-managed-environment

× This environment is externally managed
╰─> To install Python packages system-wide, try apt install
    python3-xyz, where xyz is the package you are trying to
    install.

    If you wish to install a non-Debian-packaged Python package,
    create a virtual environment using python3 -m venv path/to/venv.
    Then use path/to/venv/bin/python and path/to/venv/bin/pip. Make
    sure you have python3-full installed.

    If you wish to install a non-Debian packaged Python application,
    it may be easiest to use pipx install xyz, which will manage a
    virtual environment for you. Make sure you have pipx installed.

    See /usr/share/doc/python3.12/README.venv for more information.
```

Outdated python libraries

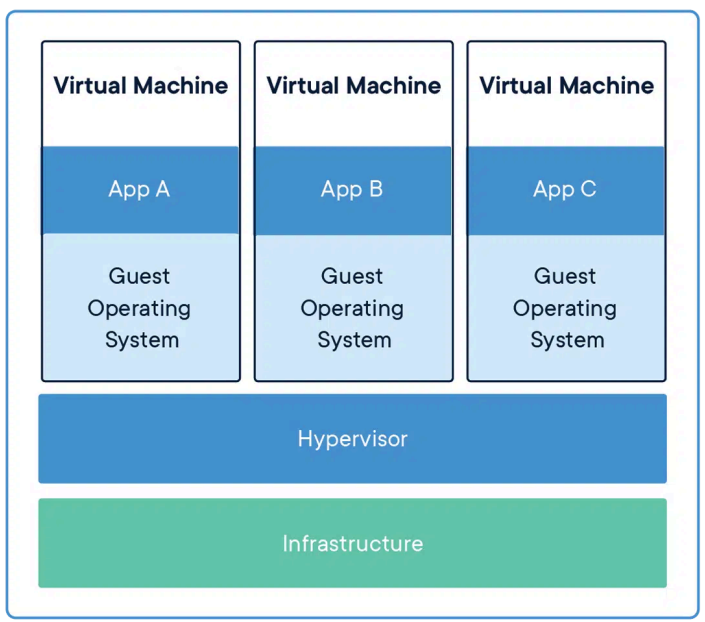
```
cr173@vcm-47003:~$ sudo pip list --outdated
```

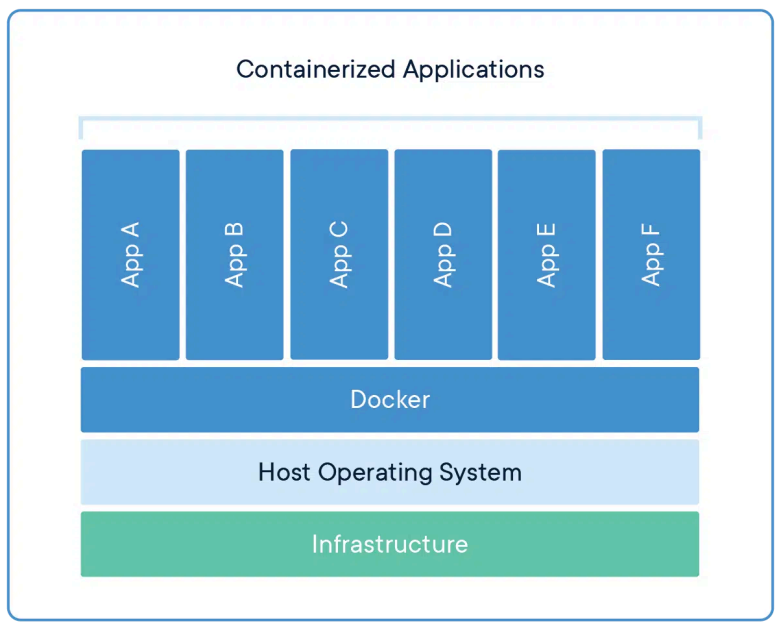
```
Package           Version        Latest      Type
----------------- -------------- ----------- -----
ansible           9.2.0          11.4.0      wheel
ansible-core      2.16.3         2.18.4      wheel
apache-libcloud   3.4.1          3.8.0       wheel
argcomplete       3.1.4          3.6.1       wheel
attrs             23.2.0         25.3.0      wheel
Automat           22.10.0        24.8.1      wheel
Babel             2.10.3         2.17.0      wheel
bcrypt            3.2.2          4.3.0       wheel
blinker           1.7.0          1.9.0       wheel
boto3             1.34.46        1.37.22     wheel
botocore          1.34.46        1.37.22     wheel
certifi           2023.11.17     2025.1.31   wheel
click             8.1.6          8.1.8       wheel
configobj         5.0.8          5.0.9       wheel
cryptography      41.0.7         44.0.2      wheel
dbus-python       1.3.2          1.4.0       sdist
```

Docker

Docker

> Docker can package an application and its dependencies in a virtual container that can run on any Linux, Windows, or macOS computer. This enables the application to run in a variety of locations, such as on-premises, in the public or private cloud. When running on Linux, Docker uses the resource isolation features of the Linux kernel (such as cgroups and kernel namespaces) and a union-capable file system to allow containers to run within a single Linux instance, avoiding the overhead of starting and maintaining virtual machines.
>
> From Wikipedia





Installation - Ubuntu / Debian

```
# Remove system packages
sudo apt-get remove docker docker-engine docker.io containerd runc

# Utililty Packages
sudo apt-get update
sudo apt-get install \
   ca-certificates \
   curl \
   gnupg \
   lsb-release

# Add apt repo signing key
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo gpg --dearmor -o /usr/share/ke

# Add apt repo
echo \
  "deb [arch=$(dpkg --print-architecture) signed-by=/usr/share/keyrings/docker-archive-keyrin
  $(lsb_release -cs) stable" | sudo tee /etc/apt/sources.list.d/docker.list > /dev/null

# Install Docker
sudo apt-get update
sudo apt-get install docker-ce docker-ce-cli containerd.io
```

Troubleshooting - daemon

```
$ sudo docker run hello-world
```

```
docker: Cannot connect to the Docker daemon at unix:///var/run/docker.sock. Is the docker daemon r
See 'docker run --help'.
```

This occurs when the docker daemon (service) is not running, this can be fixed by enabling & starting the docker service / daemon,

```
# Make sure the daemon runs automatically in the future
sudo systemctl enable docker
```

```
Synchronizing state of docker.service with SysV service script with /usr/lib/systemd/systemd-sysv-
Executing: /usr/lib/systemd/systemd-sysv-install enable docker
```

```
# Start the daemon
sudo systemctl start docker
```

Success

```
1 sudo docker run hello-world
```

```
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
1b930d010525: Pull complete
Digest: sha256:2557e3c07ed1e38f26e389462d03ed943586f744621577a99efb77324b0fe535
Status: Downloaded newer image for hello-world:latest

Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
    (amd64)
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.
```

Troubleshooting - permissions

```
docker run hello-world
```

```
docker: Got permission denied while trying to connect to the Docker daemon socket at
unix:///var/run/docker.sock: Post http://%2Fvar%2Frun%2Fdocker.sock/v1.39/containers/create:
dial unix /var/run/docker.sock: connect: permission denied.
See 'docker run --help'.
```

You must either be root or be a member of the `docker` group to use docker. Currently, your VM may or may not have a docker group and your account is likely not a member. If you get tired of typing sudo + your password there is an easy fix,

```
# Make sure the docker group exists
sudo groupadd docker

# Add your user to the docker group
sudo usermod -aG docker $USER

# Check memberships
groups
# If docker is not listed you should log out and log back in
```

Success

```
1 docker run hello-world
```

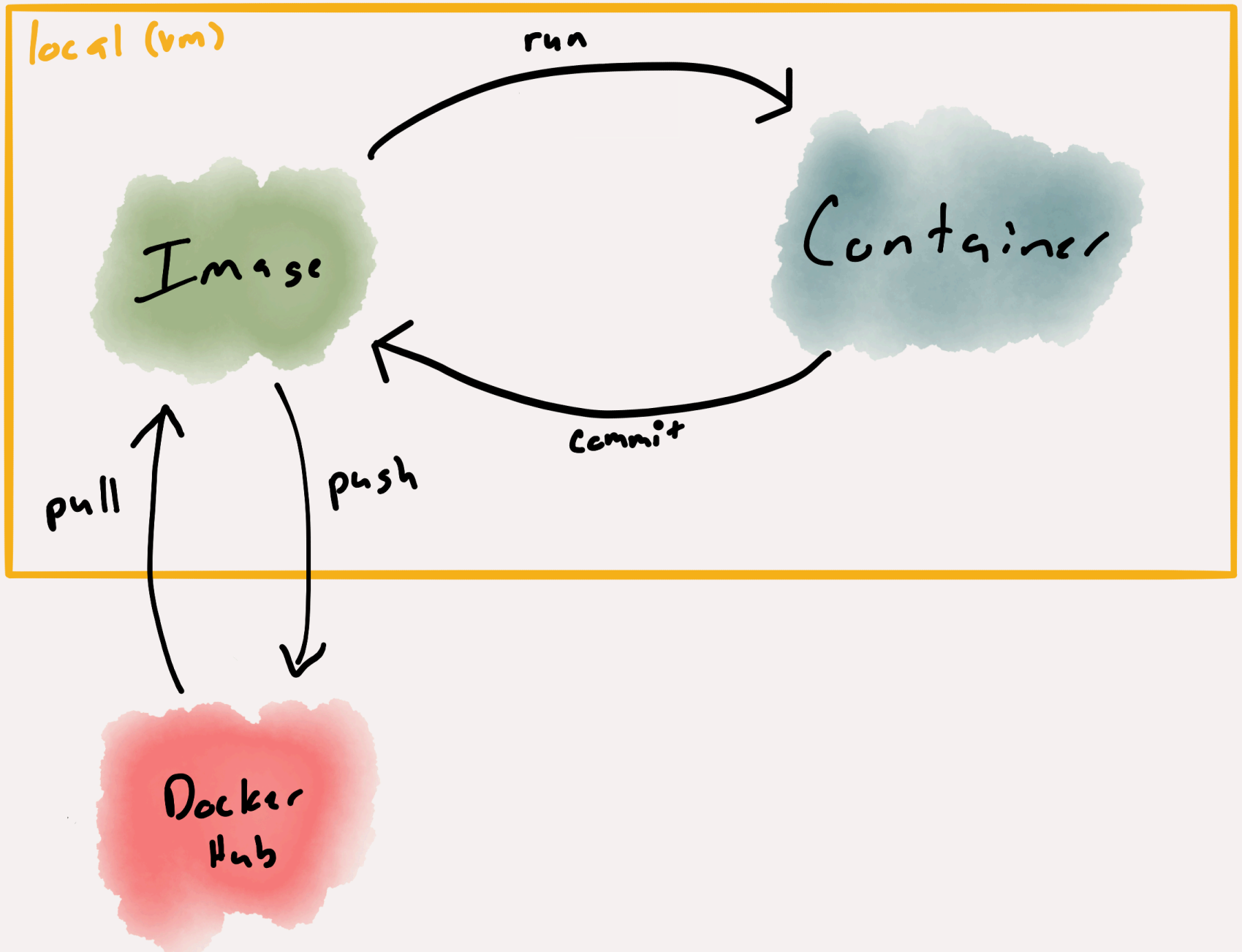
```
Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
    (amd64)
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.

To try something more ambitious, you can run an Ubuntu container with:
 $ docker run -it ubuntu bash

Share images, automate workflows, and more with a free Docker ID:
 https://hub.docker.com/
```

Getting Started


local (vm)
run
Image
Container
commit
pull
push
Docker
Hub

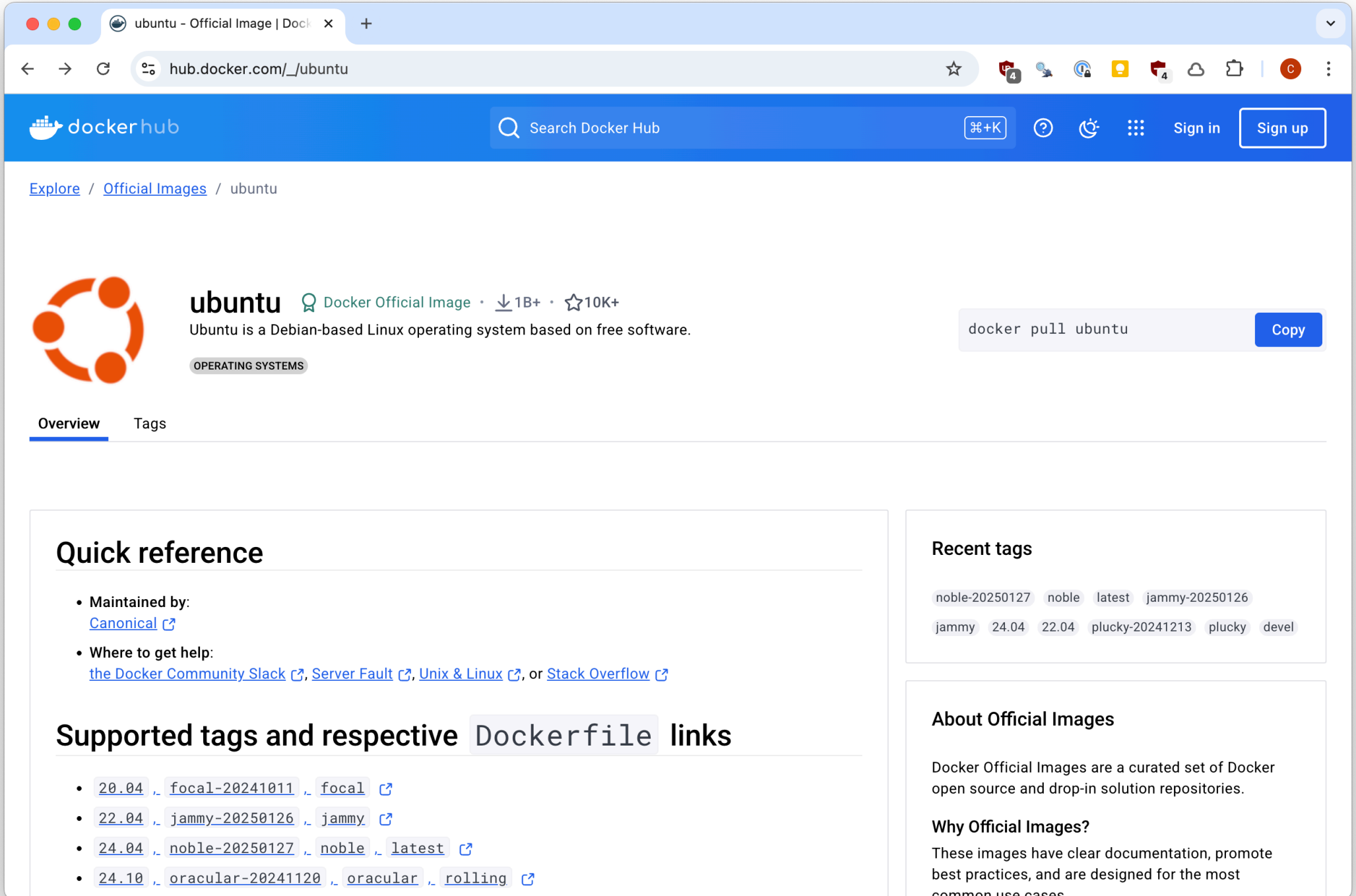
Getting images

```
1 docker pull ubuntu
```

```
Using default tag: latest
latest: Pulling from library/ubuntu
5a7813e071bf: Pull complete
Digest: sha256:72297848456d5d37d1262630108ab308d3e9ec7ed1c3286a32fe09856619a782
Status: Downloaded newer image for ubuntu:latest
docker.io/library/ubuntu:latest
```

```
1 docker images
```

```
REPOSITORY    TAG       IMAGE ID       CREATED         SIZE
ubuntu        latest    a04dc4851cbc   8 weeks ago     78.1MB
hello-world   latest    74cc54e27dc4   2 months ago    10.1kB
```


ubuntu - Official Image | Doc
hub.docker.com/_/ubuntu
dockerhub
Search Docker Hub
⌘+K
Sign in
Sign up
Explore / Official Images / ubuntu
ubuntu
Docker Official Image · 1B+ · 10K+
Ubuntu is a Debian-based Linux operating system based on free software.
OPERATING SYSTEMS
docker pull ubuntu
Copy
Overview
Tags
Quick reference
Maintained by:
Canonical
Where to get help:
the Docker Community Slack, Server Fault, Unix & Linux, or Stack Overflow
Supported tags and respective Dockerfile links
20.04 , focal-20241011 , focal
22.04 , jammy-20250126 , jammy
24.04 , noble-20250127 , noble , latest
24.10 , oracular-20241120 , oracular , rolling
Recent tags
noble-20250127 noble latest jammy-20250126
jammy 24.04 22.04 plucky-20241213 plucky devel
About Official Images
Docker Official Images are a curated set of Docker open source and drop-in solution repositories.
Why Official Images?
These images have clear documentation, promote best practices, and are designed for the most common use cases.

Tags (Versions)

```
1 docker pull ubuntu:24.10
```

```
24.10: Pulling from library/ubuntu
31734b193a81: Pull complete
Digest: sha256:102bc1874fdb136fc2d218473f03cf84135cb7496fefdb9c026c0f553cfe1b6d
Status: Downloaded newer image for ubuntu:24.10
docker.io/library/ubuntu:24.10
```

```
1 docker pull ubuntu:24.04
```

```
24.04: Pulling from library/ubuntu
Digest: sha256:72297848456d5d37d1262630108ab308d3e9ec7ed1c3286a32fe09856619a782
Status: Downloaded newer image for ubuntu:24.04
docker.io/library/ubuntu:24.04
```

```
1 docker images
```

```
REPOSITORY    TAG       IMAGE ID       CREATED         SIZE
ubuntu        24.04     a04dc4851cbc   8 weeks ago     78.1MB
ubuntu        latest    a04dc4851cbc   8 weeks ago     78.1MB
hello-world   latest    74cc54e27dc4   2 months ago    10.1kB
ubuntu        24.10     e40b6e31bd8c   4 months ago    80.1MB
```

Other sources

DockerHub is not the only source of images - their are many other possible hosts and all you need to provide is a URL along with the image name.

```
1 docker pull ghcr.io/sta663-sp25/sta663-base:latest
```

```
latest: Pulling from sta663-sp25/sta663-base
5a7813e071bf: Already exists
8b4eecc45940: Pull complete
8a0564787037: Pull complete
3696d23a471e: Pull complete
23672a6cfd33: Pull complete
942334ec7964: Pull complete
423b2646039f: Pull complete
68b5b1f45ce3: Pull complete
4f4fb700ef54: Pull complete
2b80b363e49e: Pull complete
5e022bd8982c: Pull complete
7ebaab8841b3: Pull complete
5af20e6ba13b: Pull complete
824e38cc86cc: Pull complete
b12348c1e7d6: Pull complete
5dd53c23776c: Pull complete
196321479ae8: Pull complete
```

```
1 docker images
```

```
REPOSITORY                          TAG       IMAGE ID       CREATED         SIZE
ghcr.io/sta663-sp25/sta663-base     latest    0b725e0ad9c9   3 weeks ago     7.75GB
ubuntu                              24.04     a04dc4851cbc   8 weeks ago     78.1MB
ubuntu                              latest    a04dc4851cbc   8 weeks ago     78.1MB
hello-world                         latest    74cc54e27dc4   2 months ago    10.1kB
ubuntu                              24.10     e40b6e31bd8c   4 months ago    80.1MB
```

Running a container

```
1 docker run --rm ubuntu cat /etc/os-release
```

```
PRETTY_NAME="Ubuntu 24.04.1 LTS"
NAME="Ubuntu"
VERSION_ID="24.04"
VERSION="24.04.1 LTS (Noble Numbat)"
VERSION_CODENAME=noble
ID=ubuntu
ID_LIKE=debian
HOME_URL="https://www.ubuntu.com/"
SUPPORT_URL="https://help.ubuntu.com/"
BUG_REPORT_URL="https://bugs.launchpad.net/ubuntu
PRIVACY_POLICY_URL="https://www.ubuntu.com/legal/
UBUNTU_CODENAME=noble
LOGO=ubuntu-logo
```

```
1 docker run --rm ubuntu:24.10 cat /etc/os-re
```

```
PRETTY_NAME="Ubuntu 24.10"
NAME="Ubuntu"
VERSION_ID="24.10"
VERSION="24.10 (Oracular Oriole)"
VERSION_CODENAME=oracular
ID=ubuntu
ID_LIKE=debian
HOME_URL="https://www.ubuntu.com/"
SUPPORT_URL="https://help.ubuntu.com/"
BUG_REPORT_URL="https://bugs.launchpad.net/ubuntu
PRIVACY_POLICY_URL="https://www.ubuntu.com/legal/
UBUNTU_CODENAME=oracular
LOGO=ubuntu-logo
```

```
1 docker run --rm fedora:latest cat /etc/os-release
```

```
Unable to find image 'fedora:latest' locally
latest: Pulling from library/fedora
0c5a86865c5d: Pull complete
Digest: sha256:3ec60eb34fa1a095c0c34dd37cead9fd38afb62612d43892fcf1d3425c32bc1e
Status: Downloaded newer image for fedora:latest
NAME="Fedora Linux"
VERSION="41 (Container Image)"
RELEASE_TYPE=stable
ID=fedora
VERSION_ID=41
VERSION_CODENAME=""
PLATFORM_ID="platform:f41"
PRETTY_NAME="Fedora Linux 41 (Container Image)"
ANSI_COLOR="0;38;2;60;110;180"
LOGO=fedora-logo-icon
CPE_NAME="cpe:/o:fedoraproject:fedora:41"
DEFAULT_HOSTNAME="fedora"
HOME_URL="https://fedoraproject.org/"
```

docker run common options

```
docker run [OPTIONS] IMAGE[:TAG|@DIGEST] [COMMAND] [ARG...]
```

Option	Description
`--name`	Give your container a name
`--rm`	Automatically remove the container when it exits
`-i -t`	Allow for interaction with container (STDIN & tty specifically)
`-p host:cont`	Publish a container's port
`-v host:cont`	Share filesystems
`-e "VAR=VAL"`	Define environmental variables

Other useful commands

command	Description
`docker pull NAME[:TAG]`	Pull docker image (usually from DockerHub)
`docker images`	List docker images
`docker rmi IMAGE`	Remove an image
`docker container ls [--all]`	List (all) docker containers
`docker rm CONTAINER`	Remove a container
`docker stop CONTAINER`	Stop a running container
`docker start CONTAINER`	Start a stopped container
`docker attach CONTAINER`	Attach to a running container
`docker exec CONTAINER CMD`	Runs a new command in a running container
`docker commit CONTAINER REPO[:TAG]`	Create an image from a container
`docker rename CONTAINER NAME`	Rename a container

rocker

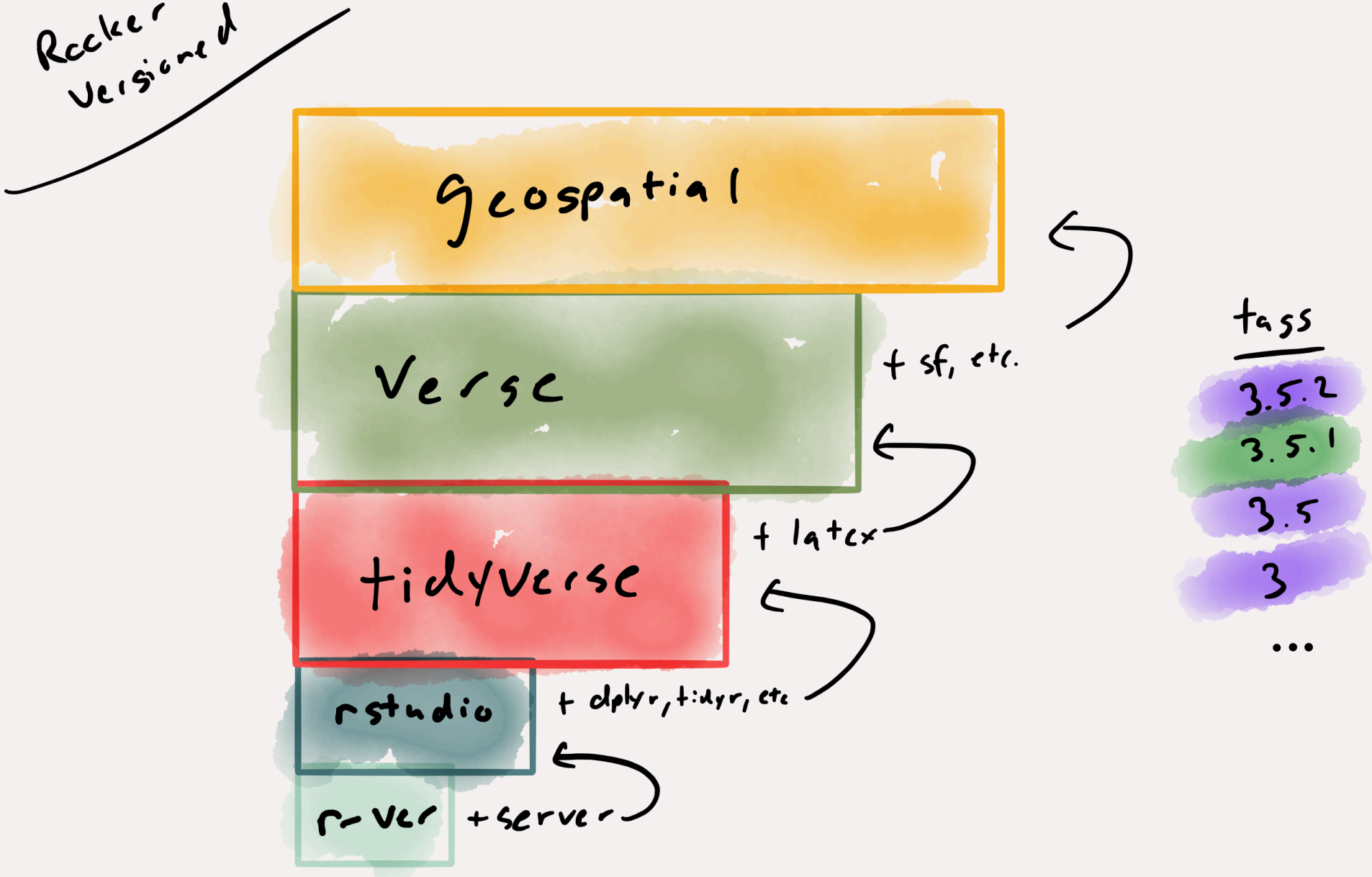
> The rocker project provides a collection of containers suited for different needs. find a base image to extend or images with popular software and optimized libraries pre-installed. Get the latest version or a reproducibly fixed environment.

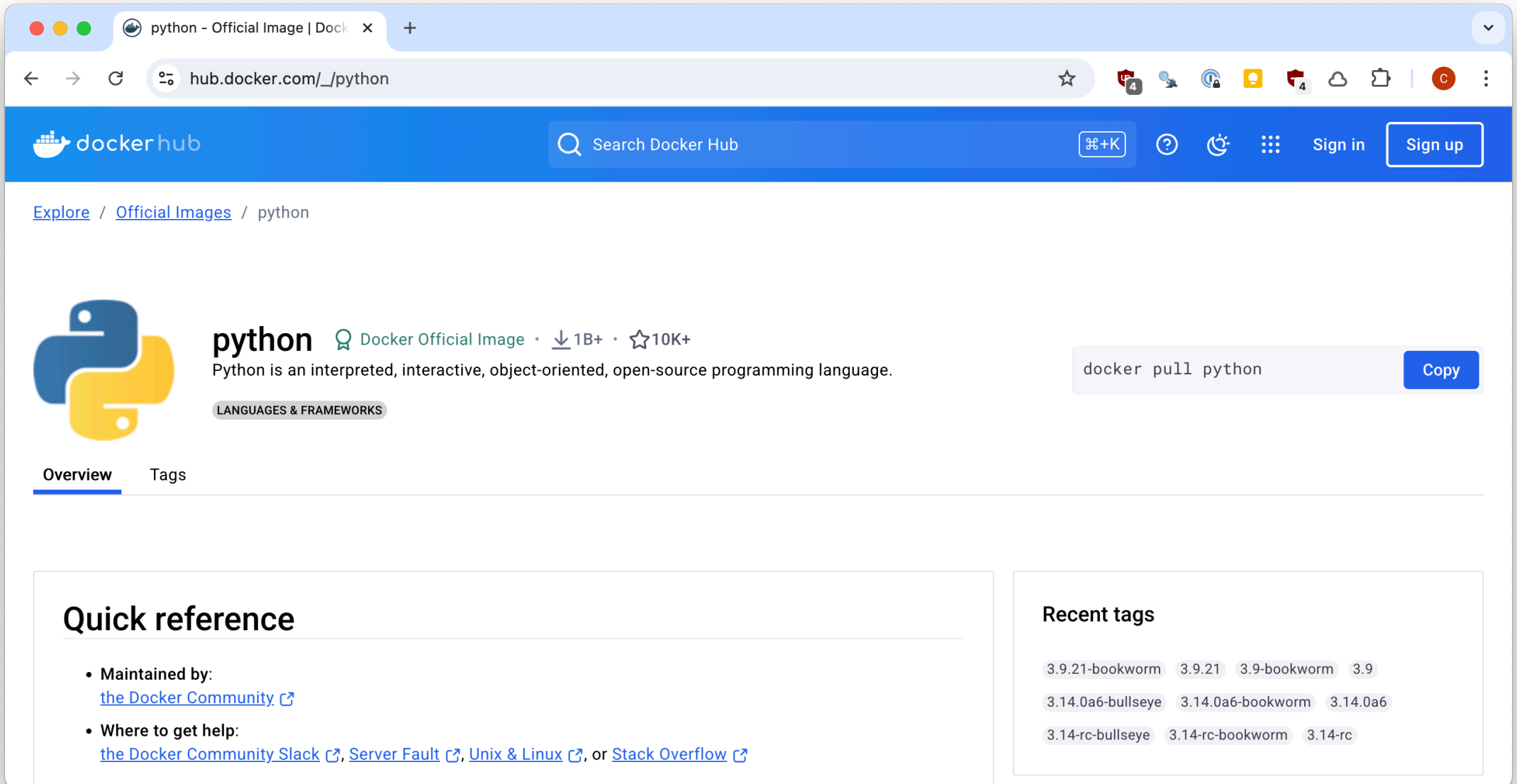
2.1 The versioned stack

image	base image	description
`rocker/r-ver`	`ubuntu`	Install R from source and set RSPM as default CRAN mirror
`rocker/rstudio`	`rocker/r-ver`	Adds RStudio Server
`rocker/tidyverse`	`rocker/rstudio`	Adds tidyverse packages & devtools
`rocker/verse`	`rocker/tidyverse`	Adds tex & publishing-related package
`rocker/geospatial`	`rocker/verse`	Adds geospatial packages
`rocker/binder`	`rocker/geospatial`	Adds requirements to run repositories on mybinder.org
`rocker/shiny`	`rocker/r-ver`	Adds shiny server
`rocker/shiny-verse`	`rocker/shiny`	Adds tidyverse packages
`rocker/cuda`	`rocker/r-ver`	Adds CUDA support to `rocker/r-ver`
`rocker/ml`	`rocker/cuda`	Adds CUDA support to `rocker/tidyverse`
`rocker/ml-verse`	`rocker/ml`	Adds CUDA support to `rocker/geospatial`

2.2 The base stack

image	base image	description
`r-base` `rocker/r-base`	`debian:testing`	Install current R from unstable repos
`rocker/r-devel`	`r-base`	R-devel added side-by-side onto r-base (using alias `RD`)
`rocker/drd`	`r-base`	Lighter `rocker/r-devel`
`rocker/drp`	`r-base`	R-patched added side-by-side onto r-base (using alias `RP`)
`rocker/r-devel-san`	`r-base`	as `rocker/r-devel`, but built with compiler sanitizers
`rocker/r-devel-ubsan-clang`	`r-base`	Sanitizers, clang c compiler (instead of gcc)


Rocker Versioned
geospatial
verse
+ sf, etc.
tidyverse
+ latex
rstudio
+ dplyr, tidyr, etc
r-ver
+ server
tags
3.5.2
3.5.1
3.5
3
...


python - Official Image | Dock
hub.docker.com/_/python
docker hub
Search Docker Hub
⌘+K
Sign in
Sign up
Explore / Official Images / python
python
Docker Official Image · 1B+ · 10K+
Python is an interpreted, interactive, object-oriented, open-source programming language.
LANGUAGES & FRAMEWORKS
docker pull python
Copy
Overview
Tags
Quick reference
Maintained by:
the Docker Community
Where to get help:
the Docker Community Slack, Server Fault, Unix & Linux, or Stack Overflow
Recent tags
3.9.21-bookworm
3.9.21
3.9-bookworm
3.9
3.14.0a6-bullseye
3.14.0a6-bookworm
3.14.0a6
3.14-rc-bullseye
3.14-rc-bookworm
3.14-rc

Docker + Python

```
1 docker pull python:latest
```

```
latest: Pulling from library/python
7cd785773db4: Pull complete
091eb8249475: Pull complete
255774e0027b: Pull complete
353e14e5cc47: Pull complete
70847531e23d: Pull complete
af0b544b1a82: Pull complete
379f06e37dbb: Pull complete
Digest: sha256:8c55c44b9e81d537f8404d0000b7331863d134db87c1385dd0ec7fefff656495
Status: Downloaded newer image for python:latest
docker.io/library/python:latest
```

```
1 docker run --rm python:latest python -V
```

```
Python 3.13.2
```

```
1 docker run --rm python:latest pip install numpy
```

```
Collecting numpy
  Downloading numpy-2.2.4-cp313-cp313-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (62
Downloading numpy-2.2.4-cp313-cp313-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (16.1 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 16.1/16.1 MB 77.0 MB/s eta 0:00:00
Installing collected packages: numpy
Successfully installed numpy-2.2.4
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviou
```

Interactive usage

For interactive use we use the `-it` (or `-i -t`) flags,

```
1 docker run -it python:latest
```

```
Python 3.13.2 (main, Mar 18 2025, 03:30:45) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

```
1 docker run -it python:latest  bash
```

```
root@0200ab573e93:/#
```

```
1 docker ps
```

```
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
```

```
1 docker ps --all
```

```
CONTAINER ID   IMAGE           COMMAND     CREATED          STATUS                      PORTS
fa52839a6bb0   python:latest   "bash"      4 seconds ago    Exited (0) 2 seconds ago
41de571bce2d   python:latest   "python3"   12 seconds ago   Exited (0) 10 seconds ago
```

Building a container interactively

```
1 docker run python:latest
```

```
root@e45df4642247:/# pip install numpy pandas seaborn
Collecting numpy
  Downloading numpy-2.2.4-cp313-cp313-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (62
Collecting pandas
  Downloading pandas-2.2.3-cp313-cp313-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (89
Collecting seaborn
  Downloading seaborn-0.13.2-py3-none-any.whl.metadata (5.4 kB)
Collecting python-dateutil>=2.8.2 (from pandas)
  Downloading python_dateutil-2.9.0.post0-py2.py3-none-any.whl.metadata (8.4 kB)
Collecting pytz>=2020.1 (from pandas)
  Downloading pytz-2025.2-py2.py3-none-any.whl.metadata (22 kB)
Collecting tzdata>=2022.7 (from pandas)
  Downloading tzdata-2025.2-py2.py3-none-any.whl.metadata (1.4 kB)
Collecting matplotlib!=3.6.1,>=3.4 (from seaborn)
  Downloading matplotlib-3.10.1-cp313-cp313-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadat
Collecting contourpy>=1.0.1 (from matplotlib!=3.6.1,>=3.4->seaborn)
  Downloading contourpy-1.3.1-cp313-cp313-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata
Collecting cycler>=0.10 (from matplotlib!=3.6.1,>=3.4->seaborn)
```

Container -> Image

```
1 docker ps --all
```

```
CONTAINER ID   IMAGE           COMMAND     CREATED              STATUS                      PORTS
e45df4642247   python:latest   "bash"      About a minute ago   Exited (0) 4 seconds ago
fa52839a6bb0   python:latest   "bash"      6 minutes ago        Exited (0) 6 minutes ago
41de571bce2d   python:latest   "python3"   6 minutes ago        Exited (0) 6 minutes ago
```

```
1 docker commit python-test python-test:latest
```

```
sha256:a69a3249750f888838192869a29cc035403c7cbe70a4c9be98fa1f6e3c2a9546
```

```
1 docker images
```

```
REPOSITORY                          TAG       IMAGE ID       CREATED          SIZE
python-test                         latest    a69a3249750f   33 seconds ago   1.3GB
ghcr.io/sta663-sp25/sta663-base     latest    0b725e0ad9c9   3 weeks ago      7.75GB
python                              latest    e6c8fe2e1108   7 weeks ago      1.02GB
ubuntu                              24.04     a04dc4851cbc   8 weeks ago      78.1MB
ubuntu                              latest    a04dc4851cbc   8 weeks ago      78.1MB
hello-world                         latest    74cc54e27dc4   2 months ago     10.1kB
ubuntu                              24.10     e40b6e31bd8c   4 months ago     80.1MB
fedora                              latest    aa6787b90fe6   4 months ago     158MB
```

Using the image

```
1 docker run --rm -it python-test:latest
```

```
root@ee76fcc4451f:/# python
Python 3.13.2 (main, Mar 18 2025, 03:30:45) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import numpy
>>> numpy.__version__
'2.2.4'
>>> import seaborn as sns
>>> sns.__version__
'0.13.2'
>>> import seaborn as sns
>>> sns.__version__
'0.13.2'
>>> import pandas as pd
>>> pd.__version__
'2.2.3'
```