Zawiki

Release v0.11-1-g7edcc8e

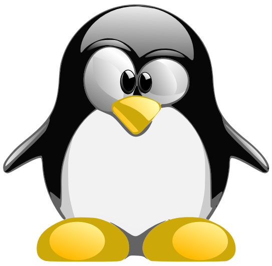
tschinz

Feb 03, 2020

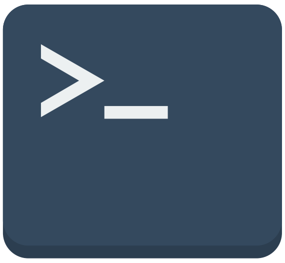
Contents

Chapter 1

Linux



1.1 Commandline



1.1.1 Cheatsheet

- *Admin rights*
- *Quit*
- *Mounting*
- *Wipe Disk*
- *Environment variables*
- *User*

- *Alias*
- *Permissions*
- *Threads*
- *General*
- *Find / Which*
- *Grep*
- *Links*
- *Compression*
    - *Tar, bz2, gz*
- *RAR*
- *In Outputs*
    - *Tail*
    - *Cat*
- *PGP Pretty Good Privacy & GPG*
    - *Files*
    - *Create PGP files*
    - *GPG Privacy*
- *SSH*
- *SCP*

Admin rights

Note: In order to gain administrative rights, for a session or only for a command

Listing 1: admin

```
sudo su
sudo "command"
sudo -s          # Longtime root
su -             # root preserved env
sudo !!          # execute previous command as root
chsh -s /bin/zsh  # change login shell to zsh
```

Quit

Listing 2: quit

```
sudo halt           # Sleep
sudo reboot         # Reboot
sudo shutdown now  # Shutdown
```

Mounting

For permanent mount see: */etc/fstab*

Listing 3: mounting

```
sudo vim /etc/fstab                # To edit default mount drives
sudo fdisk -l               # Drive info
ls -l /dev/disk/by-uuid            # get Drive UUID's
mkdir -p /media/d           # make folder for HD
mount -t vfat -o iocharset-utf8, umask=000 /dev/sda3 /media/d

mkdir -p /mnt/mountplace
mount /dev/sda1 /mnt/mountplace

unmount /mnt/mountplace

mount -U <UUID>                    # mount drive according to fstab definition

df -k                              # check partitions and the available space
```

Wipe Disk

Listing 4: wipe disk

```
# unmount disk
sudo umount /dev/sdXY -l

# use /dev/random to write Zeros on entire disk§
sudo dd if=/dev/urandom of=/dev/sdX bs=10M
```

Environment variables

They can be set permanently system wide */etc/profile* or per user shell */etc/.bashrc /etc/.zshrc*

Listing 5: environment variables

```
# Licenses
export LM_LICENSE_FILE=$LM_LICENSE_FILE:portnumber@serverip

# Print Environmemt variables
printenv
echo $name_env_var

# Set env var
setenv name value
```

User

Listing 6: user

```
# Access to different PC with unknown Password
chroot path/of/new/systemroot    # change root of FileSys
# Useful for hacking another PC
# 1. with LiveUSB / CD login
# 2. mount HD
# 3. chroot to his filessystem
# 4. Change user / password and everything else you want

# User information
who                              # returns all users logged in
whoami                           # return actual username
id <username>                    # return groups & id's of user

# Change to user
sudo -u user2 bash               # open bash of user2

# Send info
write <username> <tty>           # write to a logged user
                                 # see command who output

# Add user
sudo useradd -d /home/<username> -m <username>

# Add user to group
usermod -a -G <groupname> <username>

# Change user password
sudo passwd <username>
```

Alias

Listing 7: alias

```
# Set up aliases
alias <aliasname>="<command>"
alias ll="ls -la"
```

Permissions

Listing 8: permissions

```
chmod xxx file|folder                # xxx = rwx|xnumber
chmod -x  file |folder               # add only executable Flag
chown -R user:group file|folder      # change owner recursively

find . -type d -exec chmod 755 {} \; # find dir's and set 755
find . -type f -exec chmod 644 {} \; # find files and set 644
```

Rights			
read	write	execute	Abreviation
•	•	•	0
•	•	x	1
•	x	•	2
•	x	x	3
x	•	•	4
x	•	x	5
x	x	•	6
x	x	x	7

Threads

PID = Process ID

Listing 9: threads

```
ps -x                             # view executed threads
ps -ax | grep name                # search for specific process name
kill <pidnumber>                  # kill thread with given PID
kill signal <pidnumber>           # kill with a signal type see table below
```

Signal Name	Single Value	Effect
SIGHUP	1	Hangup
SIGINT	2	Interrupt from keyboard
SIGKILL	9	Kill signal
SIGTERM	15	Termination signal
SIGSTOP	17, 19, 23	Stop the process

General

Listing 10: general

```
uname -a                           # Distribution & Kernel informations
whereis command                    # returns location of command

mkdir /existing/path/dirname       # creates a directory
mkdir -p /non/existing/path/name   # creates a directory path
mkdir -p project/{lib/ext,bin,src,doc/{html,info,pdf},demo/stat/a}
                                   # creates a tree structure
pwd                                # print working directory
ls                                 # list content
ls -la                             # list flags
ll                                 # short list flags
cd                                 # change dir
rm name                            # remove file
rm -r                              # remove directory with content
rm -R name                         # remove recursively folder with its content
rm !(delete_all_but_this)          # delete all except !()
cp source/path /dest./path         # copy file
cp -R source/path dest./path       # copy directory with content
cp -R --preserve=mode,ownership,timestamp  source/path dest/path
                                   # copy with preserving owner and permission and␣
↪time

df                                 # show disk sizes
df -H                              # show disk sizes in KB, MB, GB


diff path/to/file1 path/to file2   # compare file1<->file2 and shows the difference
sdiff path/to/file1 path/to file2  # compare file1<->file2 and merge directly
```

Find / Which

Listing 11: find and which

```
# finding and delete all folder with <foldername> and it's content
find -type d -iname "<foldername>" -exec rm -rf {} \;
# finding and delete all files with <filename> and it's content
find -type f -iname "<filename>" -exec rm -rf {} \;
# finding all files and directories within a directory
find /etc
# finding all files within a directory
find /etc -type f
# finding all files with a suffix
find /etc -type f -name "*.conf"

# Find location of a program
which zsh
```

Grep

Grep let you search for word in files and outputs the line it was found.

Listing 12: grep

```
grep boo /etc/passwd         # search boo in for /etc/passwd
grep -r "192.168.1.5" /etc/  # search recursivaly in /etc for 192.168.1.5
grep -w "boo" /path/to/file  # search for word "boo" only
```

grep is also often uses in pipes to search within the output of an other command

Listing 13: grep pipe

```
cat /proc/cpuinfo | grep -i 'Model' # display CPU Model name
ps -x | grep vnc
```

Note: Flags

- `-r` : search recursively in all files \
- `-n` : display line number \
- `-c` : count number of times found \
- `--color` : colors the word searched in the results

Links

Listing 14: links

```
ln target-filename symbolic-filename    # create hardlink
ln -s target-filename symbolic-filename # create softlink
```

Note: Hard Link vs Softlink

Symbolic links are different from hard links. Hard links may not normally point to directories, and they cannot link paths on different volumes or file systems. Hard links always refer to an existing file.

Compression

Tar, bz2, gz

Listing 15: compress

```
tar cfv name.tar /path/to/folder      # Compression tar
tar xfv tarfile                       # Decompression tar

tar cfvz name.tar.gz /path/to/folder  # Compression tar.gz
tar xfvz tarfile                      # Decompression tar.gz

tar cfvj name.tar.bz2 /path/to/folder # Compression tar.bz2
tar xfvj tarfile                      # Decompression tar.bz2
```

Note: Flags

- c = Compression | x = eXtraction
- f = file/folder
- v = Verbose
- j = bz2 | z = gz
- p = Preserve (keep permissions)

RAR

Listing 16: compress rar

```
# compress and split in files of 700MB
rar a -m5 -v700m rarname folder_or_file_to_compress

# uncompress, if a split rar uncompress the first
rar e rarname
```

Note: Flags

- m5 = highest compression m0 = lowest compression
- e = extract in current folder
- a = append to rar
- v<SIZE>m = size of split files

In Outputs

Tail

Listing 17: tail

```
tail file folder                # give end of a file
./executable > output.txt       # redirect output to a file
./executable > output.txt 2< 1  # redirect output to a file output 2 & 1
                                # 2 = Error output
                                # 1 = Std output
```

Cat

Listing 18: cat

```
cat > file1.txt                         # To Create a new file
cat >> file1.txt                        # To Append data into the file
cat file1.txt                           # To display a file
cat file1.txt file2.txt                 # Concatenate several files and display
cat file1.txt file2.txt > file3.txt     # To cat several files and transfer output␣
↪to another file
```

PGP Pretty Good Privacy & GPG

see also *GnuPg*

Files

Listing 19: pgp files

```
/home/user/.ssh
pgp                             # private key
pgp.pub                         # public key
gpg_fingerprint.txt             # Infos for the gpg fingerprint
```

Create PGP files

Listing 20: create key's

```
ssh-keygen -t dsa -f filename   # Create private and public key
gpg --gen-key                   # Create gpg fingerprint
```

GPG Privacy

Listing 21: gpg

```
gpg --gen-key               # Create a key
gpg --export -a "User Name" > public.key# Export a public key
gpg --export-secret-key -a "User Name" > private.key# Export private key
gpg --import public.key         # Import public key
gpg --allow-secret-key-import --import private.key# Import private key
gpg --delete-key "User Name"        # Delete public key
gpg --delete-secret-key "User Name" # Delete private key
gpg --list-keys             # List key in public key ring
gpg --list-secret-keys          # Lsit key in private key ring
gpg --fingerprint > fingerprint     # Short list of numbers to verify public key
gpg -e -u "Sender User Name" -r "Receiver User Name" somefile # Encrypt data
gpg -d mydata.tar.gpg           # Decrypt data
```

SSH

See also the dedicated *SSH page*

Listing 22: ssh_config

```
# Edit config file
sudo vim /etc/ssh/sshd_config

# start, stop, restart SSH
sudo /etc/init.d/ssh start
sudo /etc/init.d/ssh stop
sudo /etc/init.d/ssh restart
```

Listing 23: ssh

```
ssh-agent bash          # start new bash agent
ssh-add privatekey      # key you want to use for that session
             # without a given key he search for ~/.ssh/id_rsa
```

Connect to another station by ssh by default a password is needed or if configured no password but with rsh keys

Listing 24: ssh connection

```
ssh -p <portnumber> -l <username> server.address.com

# or
ssh -p <portnumber> user@server.address.com

ssh -N -T -L <remoteport>:localhost:<localport> <user>@<hostname>

# or with port forward and commandline
ssh -L <remoteport>:localhost:<localport> <user>@<hostname>
```

Note: Options

- `-p <port>` - Custom port definition
- `-l <username>` - Custom username definition
- `-N` - No Output
- `-T` - No Terminal access
- `-L <remoteport>:localhost:<localport>` - Port Forwarding

SCP

Transferring file through SSH For these command you have to use either the PW or already bash started

Listing 25: scp

```
# Synchronising directories
rsync -avr -P --rsh='ssh -p YYYY' /localpath/to/dir user@host:/remotepath/to/dir

# Host -> Remote
scp sourceFile user@host:/directory/targetFile
scp -R sourceFolder user@host:/directory/targetFolder
scp -P port sourceFile user@host:/directory/targetFolder

# Remote -> Host
scp user@host:/directory/sourceFile targetFile
scp -R user@host:/directory/sourceFolder targetFolder
scp -P port user@host:/directory/sourceFolder targetFolder
```

1.1.2 Crontab

Cron allows tasks to be automatically run in the background at regular intervals by the cron daemon. These tasks are often termed as cron jobs. Crontab (CRON TABle) is a file which contains the schedule of cron entries to be run and at specified times.

Crontab is used to regularly execute some task e.g. shell scripts

Restrictions

You can execute crontab if your name appears in the file: `/usr/lib/cron/cron.allow`. If that file does not exist, you can use crontab if your name does not appear in the file: `/usr/lib/cron/cron.deny`. If only cron.deny exists and is empty, all users can use crontab. If neither file exists, only the root user can use crontab. The allow/deny files consist of one user name per line.

Crontab Viewer

To define the editor to use write the following in your `~/.bashrc`

Listing 26: ~/.bashrc

```
export VISUAL=vim
export EDITOR=vim
```

Listing 27: crontab

```
crontab -l    # List crontab's for current user
crontab -r    # Del  crontab's for current user
crontab -e    # Edit crontab's for current user
```

Crontab file

A crontab file has five fields for specifying day, date and time followed by the command to be run at that interval.

```
*   *   *   *   *   *      command to be executed
+   +   +   +   +   +
|   |   |   |   |   |
|   |   |   |   |   +--- Absolute path to script
|   |   |   |   +------- day of week  (0 - 6) (Sunday=0)
|   |   |   +----------- month        (1 - 12)
|   |   +--------------- day of month (1 - 31)
|   +------------------- hour         (0 - 23)
+----------------------- min          (0 - 59)
```

* in the value field above means all legal values as in braces for that column. The value column can have a * or a list of elements separated by commas. An element is either a number in the ranges shown above or two numbers in the range separated by a hyphen (meaning an inclusive range). Notes

- Repeat pattern like `/2` for every 2 minutes or `/10` for every 10 minutes is not supported by all operating systems. If you try to use it and crontab complains it is probably not supported.
- The specification of days can be made in two fields: month day and weekday. If both are specified in an entry, they are cumulative meaning both of the entries will get executed .

Entry Examples

A line in crontab file like below removes the tmp files from `/home/someuser/tmp` each day at 6:30 PM.

```
30     18     *     *     *         rm /home/someuser/tmp/*
```

```
:caption: crontab entries


0 * * * * /home/user/backupServerA.sh  # At Noon each day
0 0 * * * /home/user/backupServerB.sh  # At Midnight each day
0 1 * * * /home/user/backupServerC.sh  # At 1 o'clock each day
0 * * * 1 /home/user/backupServerD.sh  # At Noon each Monday
@reboot /home/user/Documents/x11vnc_start.bash
```

(continues on next page)

(continued from previous page)

```
@reboot nohup airsonos &
@weekly /home/user/script.bash > /home/user/scriptoutput.log
```

Changing the parameter values as below will cause this command to run at different time schedule below:

Frequently used times

min	hour	day/month	month	day/week	Execution time
*	*	*	*	*	Every Minute
0	*	*	*	*	Every Hour
0	0	*	*	*	Every Day
0	0	*	*	0	Every Week
0	0	1	*	*	Every Month
0	0	1	1	*	Every Year

More special times

min	hour	day/month	month	day/week	Execution time
30	0	1	1,6,12	*	00:30 Hrs on 1st of Jan, June & Dec.
0	20	*	10	1-5	8.00 PM every weekday (Mon-Fri) only in Oct.
0	0	1,10,15	*	*	Midnight on 1st ,10th & 15th of month
5,10	0	10	*	1	At 12.05,12.10 every Monday & on 10th of every month

Environment

Cron invokes the command from the user's `HOME` directory with the shell `/usr/bin/sh`. Cron supplies a default environment for every shell, defining: <code bash>

```
HOME=user's-home-directory
LOGNAME=user's-login-id
PATH=/usr/bin:/usr/sbin:.
SHELL=/usr/bin/sh
```

Disable Email

By default cron jobs sends a email to the user account executing the cronjob. If this is not needed put the following command At the end of the cron job line.

```
>/dev/null 2>&1
```

Generate log file

To collect the cron execution execution log in a file :

```
30 18 * * * rm /home/someuser/tmp/* > /home/someuser/cronlogs/clean_tmp_dir.log
```

Execute script as sudo

In order to let a crontab script run as sudo you need to give the script sudo rights without asking for a password. This can be achieved by adding the script to the root crontab instead of the user crontab. the following command will let you edit the root crontab.

```
sudo crontab -e
```

The Crontab entry will be a simple script call

```
* * * * * /location/to/script.bash
```

1.1.3 dd and ddfldd

- *Install*
- *On Linux*
- *On MacOs*

Use for creating and copying iso files from and to a medium.

The dd command doesn’t has a output during copy but dcfldd does. It gives an output all X blocks written. This means in the commands below you can also just replace dd with dcfldd.

Install

Listing 28: dcfldd install

```
sudo apt-get install dcfldd
```

On Linux

Listing 29: dd usage

```
# Create usb stick or sdcard => image
fdisk -l                                  # get disk info
unmount /dev/sdX                          # unmount disk
dd if=/dev/sdX of=/location/for/image.iso bs=1M conv=noerror,sync # copy usb stick to image

# Copy image => usb stick or sdcard
fdisk -l                                  # get disk info
unmount /dev/sdX                          # unmount disk
dd if=/location/of/image.iso of=/dev/sdX bs=1M conv=noerror,sync # copy image to usb stick
```

dd has no output normally, if you want to watch the status of the copy then open a new Terminal and try one of the following commands

Listing 30: watch dd

```
sudo kill -USR1 $(pgrep '^dd$')                         # dd will display␣
↪status once
sudo watch -n <interval in sec> kill -USR1 $(pgrep '^dd$') # dd will display␣
↪status continously
```

On MacOs

Listing 31: dd usage

```
# Create usb stick or sdcard => image
diskutil list                                 # get disk info
diskutil unmountDisk /dev/diskX               # unmount disk
dd if=/dev/diskX of=/location/for/image.iso bs=1m # copy usb stick to image

# Copy image => usb stick or sdcard
diskutil list                                # get disk info
diskutil unmountDisk /dev/diskX              # unmount disk
dd if=/location/of/image.iso of=/dev/diskX bs=1m conv=noerror,sync # copy image to␣
↪usb stick
```

1.1.4 General Shell Commands

- *Change permissions on type*
- *SSH relia*

Change permissions on type

```
sudo find /var/www -type d -print0 | sudo xargs -0 chmod 0755
sudo find /var/www -type f -print0 | sudo xargs -0 chmod 0644
```

SSH relia

```
ssh -p 2222 -L 5900:localhost:5900 -L 19999:localhost:19999 zas@relia.zapto.org
```

1.1.5 Network

Interfaces

Listing 32: interface

```
ifconfig

ifup <if_name>
ifup eth0

ifdown <if_name>
ifdown eth0

ifquery -l
```

NMAP

Find open ports on a ip subnet range

Listing 33: nmap

```
# Finding ssh server in ip range 192.168.0-192.168.0.255
nmap -p 22 --open 192.168.1.0/24
```

ARP-SCAN

Finding a machine on your local subnet using DHCP.

Listing 34: arp-scan

```
# Finding ssh server in ip range 192.168.0-192.168.0.255
sudo apr-scan --interface=eth0 --localnet | grep aa:bb:cc:dd:ee:ff
```

1.1.6 RSync

Synchronizing directories local and remotely

Listing 35: rsync

```
# Synchronising directories to distant computer
rsync -avzP --rsh='ssh -p YYYY' /localpath/to/dir user@host:/remotepath/to/dir

# Synchronizing local left to right
rsync -avP --delete --stats /source/folder/* /destination/folder

# Synchronizing and exclude a folder or file
rsync -avP --delete --stats --exclude 'excl_folder' --exclude 'folder/excl_file.txt
↪' /source/folder/* /destination/folder
rsync -avP --delete --stats --exclude-from '/home/user/exclude.txt' /source/folder/
↪* /destination/folder
```

Listing 36: exclude.txt

```
sources
public_html/database.*
downloads/test/*
```

Note: Flags

```
-a = archive (recursion & preserve rights, time, owner, group)\\
-v = verbose \\
-z = compress during transfer \\
-P = display progress \\
--delete = delete files on destination folder \\
--stats = display some statisics at the end \\
--exclude <PATTERN> = exclude file or folder \\
--exclude-from <file> = exclude list defined in file
--dry-run = show what would have been done
```

1.1.7 SSH

SSH is a useful and secure tool to connect yourself via the internet or locally with your PC remotely. It is not installed on every distribution by default.

Install

```
sudo apt-get install ssh
```

Config

```
sudo nano /etc/ssh/sshd_config
```

Define port to listen, recommend to change the default port 22

If you use FTP Port as SSH Port (21) then you will run into problems with connecting via Windows PC's because of the Windows Firewall. in order to solve this problem execute the following line on Windows PC's with Admin privilege.

```
netsh advfirewall set global statefulftp disable
```

Source your .bashrc

Create or edit the ~/.bash_profile. And add the following line to souce with each SSH Login your .bashrc

Listing 37: .bash_profile

```
source ~/.bashrc
```

Test

Test you system with via the localhost.

```
ssh -p <portnumber> localhost
```

Restart SSH

```
sudo /etc/init.d/ssh restart
```

Connect

```
ssh -p <portnumber> -l <username> server.address.com
ssh -p <portnumber> user@server.address.com
```

Port Forwarding

Listing 38: ssh connection

```
ssh -N -T -L <remoteport>:localhost:<localport> <user>@<hostname>

# or with port forward and commandline
ssh -L <remoteport>:localhost:<localport> <user>@<hostname>
```

Note: Options

- `-p <port>` - Custom port definition
- `-l <username>` - Custom username definition
- `-N` - No Output
- `-T` - No Terminal access
- `-L <remoteport>:localhost:<localport>` - Port Forwarding

RSA keys

How to setup ssh with rsa keys

Listing 39: ssh keys

```
# Generating RSA Key pair
ssh-keygen -t rsa

# Copy key
ssh-copy-id -i ~/.ssh/id_rsa.pub "user@remote.machine.com -p <portnumber>"
# OR
scp id_rsa.pub user@host:~/.ssh/machine.pub

# Append key to file authorized_keys
cat ~/.ssh/*.pub | ssh admin@server.machine.com -p <portnumber> 'umask 077; cat >>.ssh/authorized_keys'
```

1.2 Scripts

1.2.1 Config Files

- */etc/profile*
  - *Add Program to“PATH“*
- *~.bashrc .zshrc*
  - *Create a cmd alias*
- *Add custom functions*
- *etc/fstab*

- My linux configfiles

/etc/profile

/etc/profile contains Linux system wide environment and startup programs. It is used by all users with bash, zsh, sh shell. Usually used to set PATH variable, user limits, and other settings for user. It only runs for login shell. If you wanted to make large changes or application specific changes use /etc/profile.d directory.

My profile

Add Program to“PATH“

```
export PATH=$PATH:/opt/sublime_text
```

~.bashrc .zshrc

Execute commands at start of a shell instance for a given users only

.bashrc .zshrc

Create a cmd alias

Listing 40: alias

```
# Common home locations
alias home='cd ~'
alias root='cd /'
alias dtop='cd ~/Desktop'
alias dwld='cd ~/Downloads'
alias docs='cd ~/Documents'
alias www='cd /var/www/html'
# Common data directories
# Common commands
alias o=open
alias ..='cd ..'
alias ...='cd ..; cd ..'
alias ....='cd ..; cd ..; cd ..'
# Common command shortcuts
alias cls=clear
alias ll='ls -la'
alias owner-wwwdata='sudo chown -R www-data:www-data ./'
alias permission-file='sudo find . -type f -exec chmod 644 {} \;'
alias permission-folder='sudo find . -type d -exec chmod 755 {} \;'
# commands
alias backup='~/Documents/backup.bash'
```

Add custom functions

Listing 41: function

```
# Draw Mandelbrot Factral
function mandelbrot_zsh {
  local lines columns colour a b p q i pnew
  ((columns=COLUMNS-1, lines=LINES-1, colour=0))
  for ((b=-1.5; b<=1.5; b+=3.0/lines)) do
    for ((a=-2.0; a<=1; a+=3.0/columns)) do
      for ((p=0.0, q=0.0, i=0; p*p+q*q < 4 && i < 32; i++)) do
        ((pnew=p*p-q*q+a, q=2*p*q+b, p=pnew))
      done
      ((colour=(i/4)%8))
      echo -n "\\e[4${colour}m "
    done
    echo
  done
}
```

`etc/fstab`

There’s a file called /etc/fstab in your Linux system. Learn what its contents mean and how it’s used in conjunction with the mount command. When you learn to understand the fstab file, you’ll be able to edit its contents yourself, too.

My fstab

1. column - Device

- `UUID=...`
- `/dev/hda2`

2. column - Default mount point
   - `/`
   - `mnt/data`
   - `media/disk`
3. column - Filesystem type
   - `ext2`
   - `ext4`
   - `ntfs`
   - `vfat`
   - `auto`
4. column - Mount options
   - `auto and noauto` - mounted automatically at bootup
   - `user and nouser` - allows normal user to mount the device
   - `exec and noexec` - lets execute binaries from that partition
   - `ro and rw` - **R** ead- **O** nly and **R** ead- **W** rite
   - `sync and async` - data can be writte synchron or asynchron
   - `default` - means `rw,suid,dev,exec,auto,nouser,async`
5. column - Dump options
   - In most cases `0`
6. column - fck options
   - In most cases `0`

Listing 42: fstab

```
UUID=3d3920bb-91c7-4632-8fd0-1d87b110a496 /                 ext4    errors=remount-ro 0       1
/swapfile                                 none              swap    sw                0       0

# internal WD 1TB Harddisk on /dev/sda1
#UUID=377d6d5c-3d62-4155-b7f1-3f07fe09a0c2 /mnt/data2       ext4    defaults          0       0


# external Lacie Rugged 2TB Harddisk on /dev/sda1
UUID=0c6f2eed-3ec0-493e-9ab8-e954a9e3a25d /media/zas_backup ext3    nofail,nobootwait 0       0

# external WD Passport 1TB Harddisk on /dev/sde1
UUID=20F605D47F5FE7AC                     /media/zas_media  ntfs    nofail,nobootwait 0       0
```

1.2.2 Scripts

- *Shell Bang*
- *Script End*
- *Variables*
- *Command line arguments*
- *Functions*
- *Console prints*
- *User Inputs*
- *Check and create folder*
- *Lockfile*
- *Samples*

Here you can dowload some example files for Linux. It can be neither Scripts or Links or config files

A lot of scripts and configurations can be found in my config repo:

- Shell Scripts

Shell Bang

At the beginning of a file there need to be a line to indentify the program or the file. `#!<path of the program executable>`

```
#!/bin/sh
```

```
#!/bin/bash
```

```
#!/usr/bin/env python
```

Script End

```
exit 0
```

Variables

Listing 43: variables

```
# Var
SEPARATOR='--------------------------------------------------------------------------------'
INDENT='   '

# Array
MOUNT_POINTS=( 'elem1' 'elem2')

```

(continues on next page)

(continued from previous page)

```
# Use Env var
Linux_user="$USER"
```

Command line arguments

Listing 44: cli arguments

```
usage='Usage: script.bash [-v] [-h]'
usage="$usage\n\t[-n input_n] [-u input_u]"

while getopts "n:u:vh" options; do
  case $options in
    n ) var_n=$OPTARG;;
    u ) var_u=$OPTARG;;
    v ) verbose=1;;
    h ) echo -e $usage
          exit 1;;
    * ) echo -e $usage
          exit 1;;
  esac
done

if [ -n "$verbose" ] ; then
  echo "Verbose"
fi
```

Functions

Listing 45: functions

```
# Define function
function test () {
  local arg1=$1 ; local arg2=$2

  $result = $arg1 + $arg2

  return 1
}

# Usage function
test 1 2
```

Console prints

Display message welcome on screen

Listing 46: echo

```
# Console print
echo 'Welcome'

# Write message File deleted to /tmp/log.txt
echo 'File has been deleted' > /tmp/log.txt

# Append message File deleted /tmp/log.txt
```

(continues on next page)

(continued from previous page)

```
echo 'File has been deleted' >> /tmp/log.txt

# Append message and command output on screen, print variable
echo "Today's date is $(date)"
```

User Inputs

Listing 47: user inputs 1

```
echo -n "Please enter: "

stty -echo
read user_text
stty echo

echo ""          # force a carriage return to be output
```

Listing 48: user inputs 1

```
read -n1 -r -p "Press space to continue..." key
if [ "$key" = '' ]; then
    # Space pressed, do something
    # echo [$key] is empty when SPACE is pressed # uncomment to trace
else
    # Anything else pressed, do whatever else.
    # echo [$key] not empty
fi
```

Check and create folder

Listing 49: check and create folder

```
if [ ! -d "/folder/location" ]; then
  sudo mkdir /folder/location
fi
```

Lockfile

Lockfiles you can wait until another process is finished.

Listing 50: check and create folder

```
# Define path and lockfile
lockDir="/path/to/lock_files"
lockFilePath="$lockDir/lockfile.lock"
# Loop until file no longer exist
while [ -e "$lockFilePath" ]
do
    exit
done

# Create new lockfile
touch $lockFilePath

```

(continues on next page)

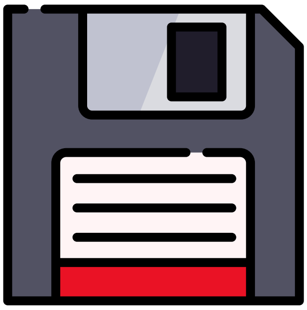
(continued from previous page)

```
TO SOMETHING THE LOCK IS YOURS

# Remove lockfile
rm -f $lockFilePath
```

Samples

```
DIR="$( cd "$( dirname "$0" )" && pwd )" # get dir of executed file
```

1.3 Tools



1.3.1 Apache

THE APACHE™ SOFTWARE FOUNDATION

- *Password Protect Apache Pages*
  - *Install Apache Packages*
  - *Create the Password File*
  - *Configure Apache Password Authentication*
  - *Access Control in Virtual Host*

Password Protect Apache Pages

When setting up a web server, there are often sections of the site that you wish to restrict access to. Web applications often provide their own authentication and authorization methods, but the web server itself can be used to restrict access if these are inadequate or unavailable.

In order to create the file that will store the passwords needed to access our restricted content, we will use a utility called htpasswd. This is found in the `apache2-utils` package within the Ubuntu repositories.

Install Apache Packages

Update the local package cache and install the package by typing this command. We will take this opportunity to also grab the Apache2 server in case it is not yet installed on the server:

```
sudo apt-get update
sudo apt-get install apache2 apache2-utils
```

Create the Password File

We now have access to the `htpasswd` command. We can use this to create a password file that Apache can use to authenticate users. We will create a hidden file for this purpose called `.htpasswd` within our `/etc/apache2` configuration directory.

The first time we use this utility, we need to add the `-c` option to create the specified file. We specify a username (test in this example) at the end of the command to create a new entry within the file:

```
sudo htpasswd -c /etc/apache2/.htpasswd test
```

You will be asked to supply and confirm a password for the user.

Leave out the `-c` argument for any additional users you wish to add:

```
sudo htpasswd /etc/apache2/.htpasswd another_user
```

If we view the contents of the file, we can see the username and the encrypted password for each record:

```
cat /etc/apache2/.htpasswd
```

Output

```
test:$apr1$lzxsIfXG$tmCvCfb49vpPFwKGVsuYz.
another_user:$apr1$p1E9MeAf$kiAhneUwr.MhAE2kKGYHK.
```

Configure Apache Password Authentication

Now that we have a file with our users and passwords in a format that Apache can read, we need to configure Apache to check this file before serving our protected content. We can do this in two different ways.

The first option is to edit the Apache configuration and add our password protection to the virtual host file. This will generally give better performance because it avoids the expense of reading distributed configuration files. If you have this option, this method is recommended.

If you do not have the ability to modify the virtual host file (or if you are already using .htaccess files for other purposes), you can restrict access using an `.htaccess` file. Apache uses `.htaccess` files in order to allow certain configuration items to be set within a file in a content directory. The disadvantage is that Apache has to re-read these files on every request that involves the directory, which can impact performance.

Choose the option that best suits your needs below.

Access Control in Virtual Host

Configuring Access Control within the Virtual Host Definition

Begin by opening up the virtual host file that you wish to add a restriction to. For example, we'll be using the `000-default.conf` file that holds the default virtual host installed through Ubuntu's apache package:

Inside, with the comments stripped, the file should look similar to this:

Listing 51: /etc/apache2/sites-enabled/000-default.conf

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    DocumentRoot /var/www/html
    ErrorLog ${APACHE_LOG_DIR}/error.log
    CustomLog ${APACHE_LOG_DIR}/access.log combined
</VirtualHost>
```

Authentication is done on a per-directory basis. To set up authentication, you will need to target the directory you wish to restrict with a `<Directory ___>` block. In our example, we'll restrict the entire document root, but you can modify this listing to only target a specific directory within the web space. Within this directory block, specify that we wish to set up **Basic authentication**. For the **AuthName**, choose a realm name that will be displayed to the user when prompting for credentials. Use the **AuthUserFile** directive to point Apache to the password file we created. Finally, we will require a valid-user to access this resource, which means anyone who can verify their identity with a password will be allowed in:

Listing 52: /etc/apache2/sites-enabled/000-default.conf

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    DocumentRoot /var/www/html
    ErrorLog ${APACHE_LOG_DIR}/error.log
    CustomLog ${APACHE_LOG_DIR}/access.log combined

    <Directory "/var/www/html">
        AuthType Basic
        AuthName "Restricted Content"
        AuthUserFile /etc/apache2/.htpasswd
```

(continues on next page)

(continued from previous page)

```
        Require valid-user
    </Directory>
</VirtualHost>
```

Save and close the file when you are finished. Restart Apache to implement your password policy:

```
sudo service apache2 restart
```

The directory you specified should now be password protected.

Configuring Access Control with `.htaccess` Files

If you wish to set up password protection using `.htaccess` files instead, you should begin by editing the main Apache configuration file to allow `.htaccess` files:

Find the `<Directory>` block for the `/var/www` directory that holds the document root. Turn on `.htaccess` processing by changing the **AllowOverride** directive within that block from `None` to `All`:

Listing 53: /etc/apache2/apache2.conf

```
...
<Directory /var/www/>
    Options Indexes FollowSymLinks
    AllowOverride All
    Require all granted
</Directory>
...
```

Next, we need to add an .htaccess file to the directory we wish to restrict. In our demonstration, we'll restrict the entire document root (the entire website) which is based at `/var/www/html`, but you can place this file in any directory you wish to restrict access to `/var/www/html/.htaccess`.

Within this file, specify that we wish to set up **Basic authentication**. For the **AuthName**, choose a realm name that will be displayed to the user when prompting for credentials. Use the **AuthUserFile** directive to point Apache to the password file we created. Finally, we will require a valid-user to access this resource, which means anyone who can verify their identity with a password will be allowed in:

Listing 54: /var/www/html/.htaccess

```
AuthType Basic
AuthName "Restricted Content"
AuthUserFile /etc/apache2/.htpasswd
Require valid-user
```

Save and close the file. Restart the web server to password protect all content in or below the directory with the `.htaccess` file:

```
sudo service apache2 restart
```

To confirm that your content is protected, try to access your restricted content in a web browser. You should be presented with a username and password prompt.

If you enter the correct credentials, you will be allowed to access the content. If you enter the wrong credentials or hit "Cancel", you will see the "Unauthorized" error page:

1.3.2 Hardware Sensors

- *Installation*
- *Setup*
- *Loading modules*
- *Monitoring*

Installation

```
sudo apt-get install lm-sensors hddtemp
```

- `lm-sensors` reads the mainboard sensors
- `hddtemp` reads the S.M.A.R.T. enables harddisk sensors

Setup

Running `sensors-detect`

```
sudo sensors-detect
```

Answer to ALL questions with YES, especially to the last one “Do you want to add these lines to `/etc/modules` automatically.

Loading modules

Since we don’t want to restart; load the modules manually. Therefore load the modules displayed at the end of the previous command.

```
#----cut here----
# Chip drivers
coretemp
#----cut here----
```

Run command

```
sudo modprobe [modulename]
```

Monitoring

To read the sensors by coimmandline enter:

```
sensors
```

There are also gui available for all desktop environments.

- Gnome: `sudo apt-get install sensors-applet`
- KDE: Build in Widget

1.3.3 Let's Encrypt

- *Version*
- *Renew Certificates*

Version

```
certbot --version
```

Renew Certificates

```
# Stop Webserver Service
sudo service apache2 stop

# Update Certificates
sudo certbot renew
sudo certbot renew --dry-run

# Restart Webserver Service
sudo service apache2 start
```

1.3.4 Raid

- *Types*
  - *Raid types*
  - *Non-Raid types*
- *mdadm Commands*
  - *Check Raid Status*
  - *Create Raid Array*
  - *Change Raid Array*
    - *Grow*
    - *Delete Raid Array*
- *Links*

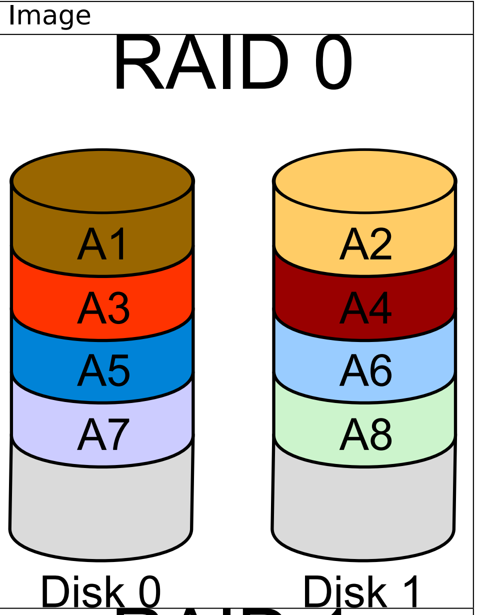
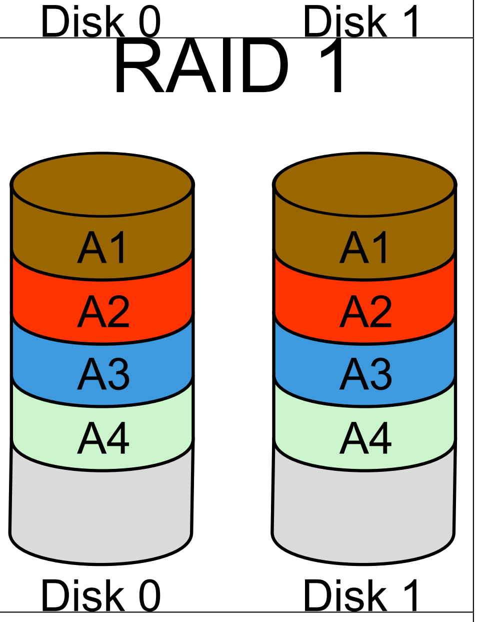
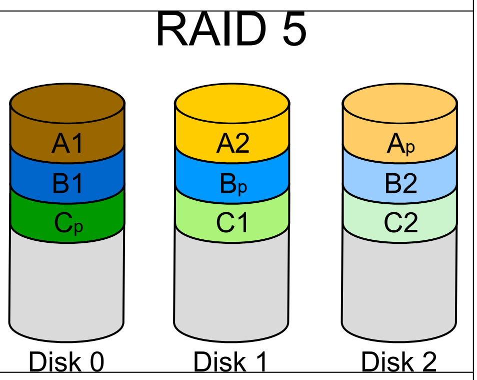
Raid (**R** edundant **A** rray of **I** ndependent **D** isks) is a system to connect multiple harddisks together to increase the size, the performance or the security of those drives.

Raid can be done via a specific hardware implementation, which is expensive; or a software implementation, which adds overhead and decreases your CPU performance.

On this page only the software implementation using the mdadm (**M** ulti **D** rive **Adm** inistration) is covered.

Types

Raid types

Type ^ Description		Image
RAID 0	Block level striping. MD can handle devices of different lengths, the extra space on the larger device is then not striped	 RAID 0 A1 A3 A5 A7 A2 A4 A6 A8 Disk 0 Disk 1
RAID 1	Mirror	 RAID 1 A1 A2 A3 A4 A1 A2 A3 A4 Disk 0 Disk 1
RAID 4	Like RAID 0, but with an extra device for parity	
RAID 5	Like RAID 4, but with the parity distributed across all devices	 RAID 5 A1 B1 C_p A2 B_p C1 A_p B2 C2 Disk 0 Disk 1 Disk 2
RAID 6	Like RAID 5, but with two parity segments per stripe	
RAID 10	Take a number of RAID 1 mirrorsets and stripe across them RAID 0 style	

Non-Raid types

- **LINEAR** – Concatenate a number of devices into a single large MD device.
- **MULTIPATH** – Provide multiple paths with failover to a single device.
- **FAULTY** – A single device which emulates a number of disk fault scenarios for testing and development.
- **CONTAINER** – A group of devices managed as one, in which RAID systems can be built.

mdadm Commands

Check Raid Status

```
cat /proc/mdstat
sudo mdadm --query --detail /dev/md* # * = md number e.g. md0
```

Create Raid Array

Create a RAID 1 (mirror) array from two partitions. If the partitions differ in size, the array is the size of the smallest partition.

```
mdadm --create /dev/md0 --level=mirror --raid-devices=2 /dev/sda1 /dev/sdb1
```

Create a RAID 5 volume from three partitions. If the partitions used in your RAID array are not the same size, mdadm will use the size of the smallest from each partition. If you receive an error, such as: `mdadm: RUN_ARRAY failed: Invalid argument`, make sure your kernel supports (either via a module or by being directly compiled in) the raid mode you are trying to use. Most modern kernels do, but you never know…

```
mdadm --create /dev/md1 --level=5 --raid-devices=3 /dev/sda2 /dev/sdb2 /dev/sdc2
```

Change Raid Array

Grow

This adds the new device to the array then grows the array to use its space.

```
mdadm --add /dev/md1 /dev/sdd1
mdadm --grow /dev/md1 --raid-devices=4
```

Delete Raid Array

```
mdadm --stop /dev/md0        # to halt the array
mdadm --remove /dev/md0      # to remove the array
mdadm --zero-superblock /dev/sd[abc]1  # delete the superblock from all drives in the array
vim /etc/mdadm/mdadm.conf    # delete any rows related to deleted array
```

Links

- MDADM Wikipedia article
- Official mdadm webpage

1.3.5 Samba

- *Server*
  - *Installation Server*
  - *Configuration*
  - *User*
  - *Creating Share*
  - *Restart Samba*
  - *Test*
- *Client*
  - *Installation Client*
  - *Create shared folder*
  - *Set Up FSTAB*

Samba is useful for a creating a Network directory and share it with other PC, especially Windows.

Server

For creating a server who shares a drive

Installation Server

```
sudo apt-get install samba
```

Configuration

Under global add the following lines or uncomment them in your file etc/samba/smb.conf

Listing 55: /etc/samba/smb.conf

```
[global]
        # Permission on newly created files and folders
        create mask = 0644
        directory mask = 0755

        # add user security
        security = user
        encrypt passwords = true
        map to guest = bad user
```

User

```
# Create User
sudo  smbpasswd -a username

New SMB password:
Retype new SMB password:
Added user username.

# Activate User
sudo smbpasswd -e username
Enabled user username.
```

Creating Share

Add the end of the file /etc/samba/smb.conf add your shares

Listing 56: /etc/samba/smb.conf

```
[multimedia]
        comment = multimedia
        path = /mnt/multimedia
        browseable = yes
        read only = no
```

Restart Samba

```
# Linux in general
sudo /etc/init.d/samba restart
# Ubuntu >10.04
sudo initctl restart smbd
```

Test

To test samba and display all available shares for the current user type:

```
smbclient -L <hostname or ipname>
```

Client

For mounting a shared drive

Installation Client

Install samba tools.

```
sudo apt-get install samba smbfs
```

Create shared folder

Create before an empty folder where you want to mount your samba drive.

```
sudo mkdir /mnt/shared_folder_name
```

Set Up FSTAB

Open `etc/fstab` file and add a new entry . See also *etc/fstab*

Listing 57: /etc/fstab

```
# only read access
//SERVER/shares /MOUNTPOINT smbfs username=samba_user,password=samba_pass 0 0

# read / write access
//SERVER/shares /MOUNTPOINT smbfs username=samba_user,password=samba_pass,uid=this_
↪user,gid=this_group 0 0
```

1.3.6 Shairport

- *Install*
- *Run Shairport*
- *Autostart*

Linux can receive AirPlay audio using a program called Shairport. Shairport tries to emulate the Airport system of Apple. This version allows to stream music from a device e.g. Smartphone, Tablet, PC to the Airport Server which then play the music. The device need to be in the same Network.

Install

Download AirPlay (Shairport)

```
cd /tmp
sudo git clone https://github.com/abrasive/shairport.git shairport
```

Install dependencies

```
sudo apt-get install libssl-dev libavahi-client-dev libasound2-dev build-essential
```

Configure the Shairport build

```
cd shairport
./configure
```

Make & install Shairport

```
sudo make
sudo make install
```

Identify your audio output device

```
x@z:~$ aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: PCH [HDA Intel PCH], device 0: ALC892 Analog [ALC892 Analog]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
card 0: PCH [HDA Intel PCH], device 1: ALC892 Digital [ALC892 Digital]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
card 0: PCH [HDA Intel PCH], device 3: HDMI 0 [HDMI 0]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
card 0: PCH [HDA Intel PCH], device 7: HDMI 1 [HDMI 1]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
```

Setup the firewall I use `ufw` to do this:

```
sudo ufw allow from 192.168.1.1/16 to any port 3689 proto tcp
sudo ufw allow from 192.168.1.1/16 to any port 5353
sudo ufw allow from 192.168.1.1/16 to any port 5000:5005 proto tcp
sudo ufw allow from 192.168.1.1/16 to any port 6000:6005 proto udp
sudo ufw allow from 192.168.1.1/16 to any port 35000:65535 proto udp
```

Run Shairport

```
shairport -v -a 'Airplay receiver name' -o alsa-- -d hw:1,1
```

Add `-v` to the above for debugging info, `-vv` for more debug info and `-vvv` for even more debug info!

Autostart

For automatically start shairport you can use the script that comes with the source. Just copy the script you need to the init.d directory.

```
sudo cp scripts/debian/init.d/shairport /etc/init.d/
```

1.3.7 Subsonic

- *Installation*
  - *Install Java*
  - *Install Madsonic*
- *Configuration and Service*
  - *Add Transcoding*
  - *If somethings goes wrong*
- *Jukebox*
  - *Selecting the Soundcard*

(Sub)Madsonic is a free, web-based media streamer, providing ubiquitous access to your music. Use it to share your music with friends, or to listen to your own music while at work. You can stream to multiple players simultaneously, for instance to one player in your kitchen and another in your living room.

(Sub)Madsonic is designed to handle very large music collections (hundreds of gigabytes). Although optimized for MP3 streaming, it works for any audio or video format that can stream over HTTP, for instance AAC and OGG. By using transcoder plug-ins, (Sub)Madsonic supports on-the-fly conversion and streaming of virtually any audio format, including WMA, FLAC, APE, Musepack, WavPack and Shorten.

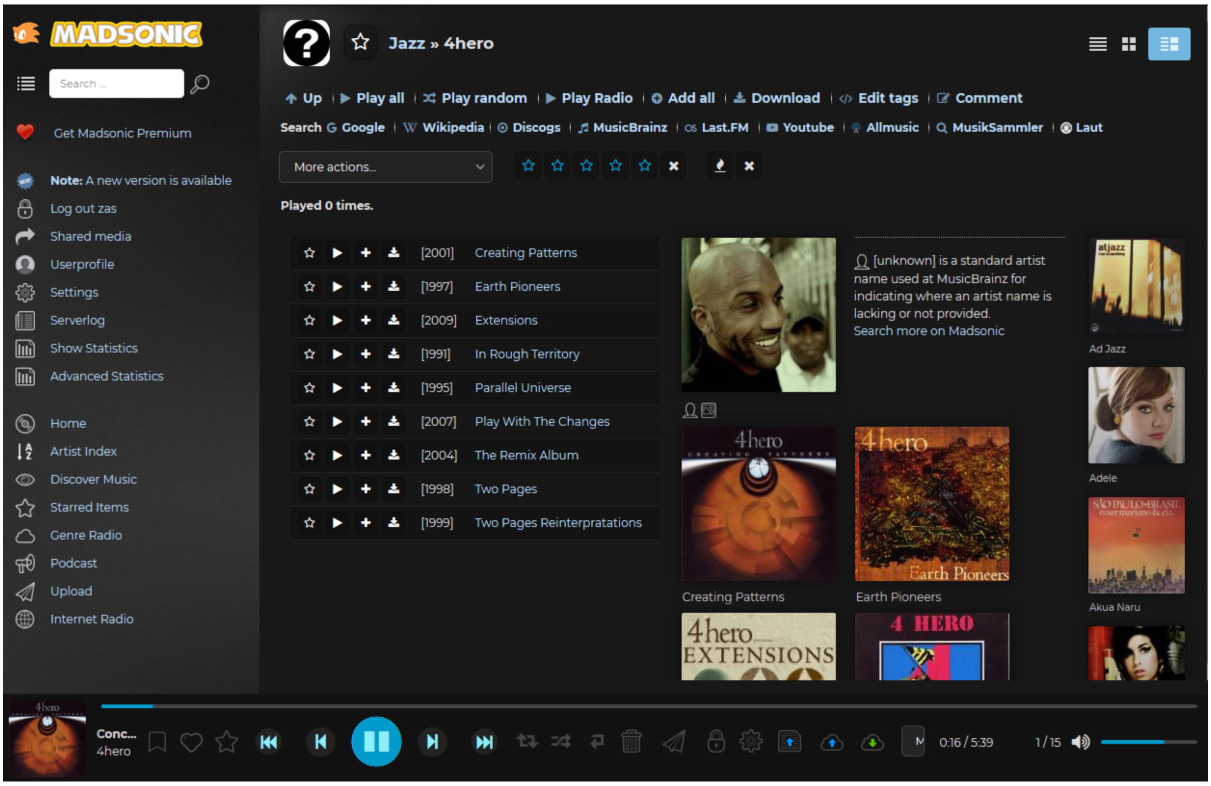
If you have constrained bandwidth, you may set an upper limit for the bitrate of the music streams. (Sub)Madsonic will then automatically resample the music to a suitable bitrate.

Installation

For installation instructions see also here. My madsonic configuration can be see in the config repo: madsonic config

Install Java

```
sudo apt-get install openjdk-8-jre
```



[2001] Creating Patterns
[1997] Earth Pioneers
[2009] Extensions
[1991] In Rough Territory
[1995] Parallel Universe
[2007] Play With The Changes
[2004] The Remix Album
[1998] Two Pages
[1999] Two Pages Reinterpratations

[unknown] is a standard artist name used at MusicBrainz for indicating where an artist name is lacking or not provided.
Search more on Madsonic

Figure1: Madsonic Webinterface

Install Madsonic

There are 2 good Subsonic versions. The official subsonic version, very stable, fast and reliable and the MadSonic Mod from MadEvil. It has several improvements and feature additions.

- Download the Subsonic .deb package and install it:

```
sudo dpkg -i subsonic-x.x.deb
```

- Download the MadSonic .deb package and install it:

```
sudo dpkg -i Madsonic-x.x.xxxx.deb
```

- Test the system on a local browser with the address http://localhost:4040

Configuration and Service

- Log into change the admin password first
- Recommended to change advanced settings as well, like Java Memory, Port Number, Startup Settings
  - Edit the SUBSONIC_ARGS variable in /etc/default/subsonic or /etc/default/madsonic
- Restart the service

```
sudo service subsonic restart
# or
sudo service madsonic restart
```

Add Transcoding

In order that Subsonic can use the powerful transcoding feature you need to install some third-party transcoders:

```
sudo apt-get install lame flac faad vorbis-tools
```

If somethings goes wrong

Check the logs in `/var/madsonic`.

Jukebox

In order to get the Jukebox to work, the soundcard needs to be set up first.

The user that is running (Sub)Madsonic needs to have access to the soundcard. For Ubuntu this means adding that user to the `audio` group in `/etc/group`.

```
useradd -G audio username
```

Selecting the Soundcard

First you need to find out what your soundcards are named in the sound library used in Java.

Create the following file

Listing 58: audioDevList.java

```
import java.io.*;
import javax.sound.sampled.*;

public class audioDevList{
  public static void main(String args[]){

    //Get and display a list of
    // available mixers.

    Mixer.Info[] mixerInfo = AudioSystem.getMixerInfo();
    System.out.println("Available mixers:");
    for(int cnt = 0; cnt < mixerInfo.length;cnt++){
      System.out.println(mixerInfo[cnt].
      getName());
    }
  }
}
```

And then run

```
javac audioDevList.java
java audioDevList
```

If you get an error about javac not found, you need to install the JDK (e.g. openjdk-8-jdk).

```
sudo apt-get install openjdk-8-jdk
```

Here is a sample output of the script:

```
Available mixers:
NVidia [plughw:0,3]
NVidia [plughw:0,7]
NVidia [plughw:0,8]
NVidia [plughw:0,9]
Intel [plughw:1,0]
CX8801 [plughw:2,0]
Port NVidia [hw:0]
Port Intel [hw:1]
Port CX8801 [hw:2]
```

</code> Linux / Mac : Modify your `/usr/bin/subsonic/subsonic_run.sh` (for Ubuntu package install) and add the following line. Note the single quotes and the hash mark # before the sound card name. Those are required.

```
'-Djavax.sound.sampled.SourceDataLine=#PCH [plughw:0,0]' \
```

Restart the subsonic service

```
sudo service subsonic restart
# or
sudo service madsonic restart
```

Once Music is played in jukebox mode the audio is not available anymore to other programs. To cut this restart sub/madsonic as above shown.

1.3.8 Systemd

- *List services*
- *Status service*
- *Start Stop Service*
- *Add Service*
- *Add in vim file*
- *Start Service manually*
- *Start Service on boot*

List services

```
systemctl --type=service
```

Status service

```
systemctl status firewalld.service
```

Start Stop Service

```
systemctl stop firewalld.service
systemctl status firewalld.service
```

Add Service

```
cd /etc/systemd/system
sudo vim jupyterlab.service
```

Add in vim file

```
[Unit]
Description = Jupyterlab service
After = network.target
StartLimitIntervalSec=0

[Service]
Type=simple
User=zas
ExecStart=/home/zas/Documents/jupyterlab_start.bash

[Install]
WantedBy = multi-user.target
```

Start Service manually

```
systemctl start jupyterlab
```

Start Service on boot

```
systemctl enable jupyterlab
```

1.3.9 VIM

- *Cheat Sheet*
- *SWP Files*
- *Commands*
  - *Edit & Save & Quit*
  - *File*
  - *Tab*
  - *Split screen*
  - *Search*
  - *Replace*
  - *Modes*
  - *Edit*
  - *Macro*
  - *Console*
- *.vimrc*

Vim is a text editor written by Bram Moolenaar and first released publicly in 1991. Based on the vi editor common to Unix-like systems, Vim is designed for use both from a command line interface and as a standalone application in a graphical user interface.

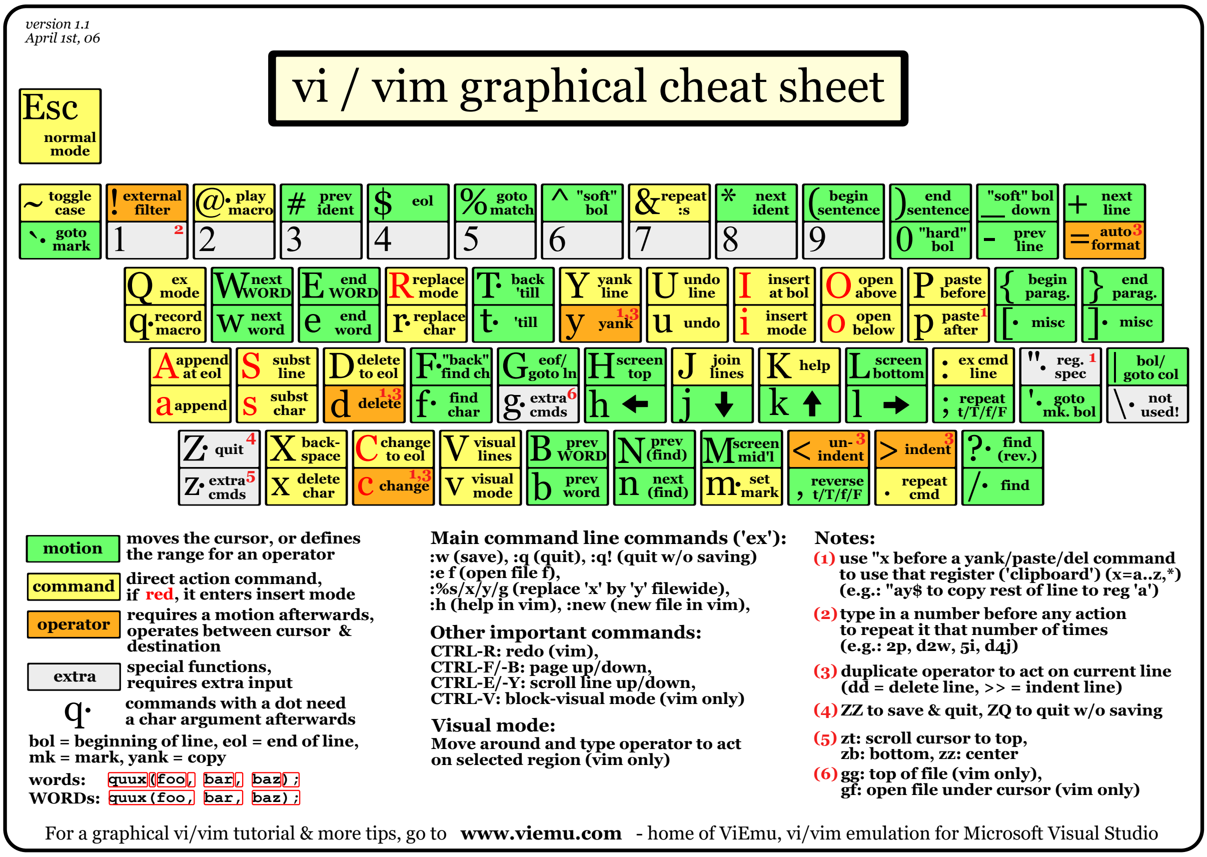
Cheat Sheet

The Vim Cheat Sheet was done by http://michael.peopleofhonoronly.com/vim/.

SWP Files

If working remotely Vim generated swap file. If you're sure that your work is safely storey you can get rid of the swapfiles with the follwing commands:

```
find . -name ".*.swp"                # find swap files
find . -name ".*.swp" | xargs rm -f  # find and delete
```



motion — moves the cursor, or defines the range for an operator

command — direct action command, if red, it enters insert mode

operator — requires a motion afterwards, operates between cursor & destination

extra — special functions, requires extra input

q· — commands with a dot need a char argument afterwards

bol = beginning of line, eol = end of line, mk = mark, yank = copy

words: quux(foo, bar, baz);
WORDs: quux(foo, bar, baz);

Main command line commands ('ex'):
:w (save), :q (quit), :q! (quit w/o saving)
:e f (open file f),
:%s/x/y/g (replace 'x' by 'y' filewide),
:h (help in vim), :new (new file in vim),

Other important commands:
CTRL-R: redo (vim),
CTRL-F/-B: page up/down,
CTRL-E/-Y: scroll line up/down,
CTRL-V: block-visual mode (vim only)

Visual mode:
Move around and type operator to act on selected region (vim only)

Notes:
(1) use "x before a yank/paste/del command to use that register ('clipboard') (x=a..z,*) (e.g.: "ay$ to copy rest of line to reg 'a')
(2) type in a number before any action to repeat it that number of times (e.g.: 2p, d2w, 5i, d4j)
(3) duplicate operator to act on current line (dd = delete line, >> = indent line)
(4) ZZ to save & quit, ZQ to quit w/o saving
(5) zt: scroll cursor to top, zb: bottom, zz: center
(6) gg: top of file (vim only), gf: open file under cursor (vim only)

For a graphical vi/vim tutorial & more tips, go to **www.viemu.com** - home of ViEmu, vi/vim emulation for Microsoft Visual Studio

Figure2: Vim Cheatsheet

Commands

Edit & Save & Quit

Command	Description
`:e <filename>`	Open and **e** dit `<filename>`
`:w`	**w** rite file
`:w <filename>`	**w** rite file in `<filename>`
`:wq`	**w** rite and **q** uit
`:wq <filename>`	**w** rite file in `<filename>` and **q** uit
`:wq!`	**w** rite and **q** uit

File

Command	Description
`:ls`	**l** i **s** t current buffers & files
`:e`	Open integrated File **e** xplorer
`:Sex`	**S** plit windows and open integrated File **ex** plorer

Tab

open multiple files as tabs in vim > 7.0

```
vim -p file1 file2 file3
```

Command	Description
`:tabe <filepath>`	**tab** ulator **e** dit (add file as new tab)
`:tabn`	**tab** **n** ext
`:tabp`	**tab** **p** revious
`gt`	**g** oto next **t** ab
`gT`	**g** oto previous **t** ab

Split screen

Command	Description
:sb <filepath>	Add file in horizontal split
:vs <filepath>	Add file in **v** ertical **s** plit
^w <arrow>	Jump to screen in the arrow direction

Search

Regex

Command	Description
/<regex>	Search for a Regex pattern
:noh	Stop Highlight search results
AltGr + #	Search/Highlight current word
/word	Search word from top to bottom
?word	Search word from bottom to top
/jo[ha]n	Search john or joan
/\< the	Search the, theatre or then
/the\>	Search the or breathe
/\< the\>	Search the
/fred|joe	Search fred or joe
/\<\d\d\d\d\>	Search exactly 4 digits
/^\n\{3}	Find 3 empty lines
:bufdo /searchstr/	Search in all open files

Replace

Command	Description
:%s/<regex>/replacer/cmd	Replace Regex search with replacer
:%s/foo/bar/g	replace foo with bar auto
:%s/foo/bar/gc	replace foo with bar ask **c** onfirmation

Modes

Command	Description
i	**I** nsert Mode
R	**R** eplace Mode
a	**A** ppend Mode
v	**V** isual Mode
V	**V** isual Line Mode
Ctrl + v	**V** isual Block Mode
u	**U** ndo

Edit

Command	Description
`d`	**D** elete (also used as Cut)
`D`	**D** elete to eol (also used as Cut to eol)
`y`	**Y** ank (copy)
`Y`	**Y** ank (copy) line
`<`	shift left (marked lines)
`>`	shift right (marked lines)

Macro

Command	Description
`q <macroname>`	1 start recording <macroname> = lowercase letter
`to what you want`	2 Perform the repetetive editing
`q`	3 Stop recording
`@ <macroname>`	4-1 Play recording <macroname> = lowercase letter from before
`<nbr> @ <macroname>`	4-2 Play recording multiple times <nbr> = number of times

Console

Execute a console command. Vim will be halted and the console from within Vim was opened will execute the program and go back to Vim after execution is complete.

Command	Description
`:!<console command>`	Executes command in the console

.vimrc

Listing 59: .vimrc

```
set nocp

set autoindent
set backspace=2
set backup
set hidden
set history=500
set hlsearch
set incsearch
set listchars=precedes:$,extends:$,tab:>-,trail:.,eol:<
" Line numbers "
set number
set printheader=%<%F%=Seite\ %N
set ruler
set shiftwidth=2
set showcmd
set showmatch
set showmode
set sidescroll=5
```

(continues on next page)

(continued from previous page)

```
set smartcase
set smartindent
set softtabstop=2
set spelllang=de,en
set spellsuggest=double,10
set statusline=%<%f\ %h%m%r%=%([%{Tlist_Get_Tagname_By_Line()}]%)\ #%n\ %-14.(%l/
↪%L,%c%V%)\ %P
set tabstop=2
" set textwidth=75 "
set title
set wildmenu
set wildmode=list:longest,full

" Use Windows Clipboard "
if has("win32")
    set clipboard=unnamed
endif

" Syntax Highlighting "
syntax on

" Filename Detection
filetype on
filetype indent on
filetype plugin on

" Folding
"syntax sync fromstart
set foldmethod=indent
set nofoldenable
```

Download my .vimrc

1.3.10 VNC Remote Control

- *x11vnc*
  - *Install*
  - *Config*
  - *Start*
  - *Autostart*
- *VNC over SSH*
  - *Linux*
    - *Open SSH Tunnel*
    - *Launch VNC Viewer in Linux*
  - *Windows*
    - *Putty Config*
    - *Start VNC*
    - *Troubleshooting*
  - *Macintosh*

    - *Install Tools*
    - *Set up SSH Tunnel*
    - *Launch VNC Viewer in Mac*
- *Putty*

VNC is a protocol to let you connect and view the screen of your remote controlled PC. But this isn't very secure and should not be enabled over the internet but only locally. VNC is often used to hack Linux PC. Therefore you should use VNC over SSH where the data is encrypted and very secure.

x11vnc

Perfect fast and configurable solution for almost all Linux distributions. x11vnc does not create an extra display (or X desktop) for remote control. Instead, it uses the existing X11 display shown on the monitor of a Unix-like computer in real time.

Install

```
sudo apt-get install x11vnc
```

Config

Generate password file

```
x11vnc -storepasswd
Enter VNC password:
Verify VNC password:
```

The password in now store by default in the file `~/.vnc/passwd`

Start

```
x11vnc -usepw -forever -display :0 -safer -bg -o /home/user/Documents/log/vnc/
↪x11vnc.log -localhost
```

- `-forever` : listen forever to input connections
- `-display :<nbr>` : Define display to use
- `-usepw` : uses password file stored in `~/.vnc/passwd`
- `-safer` : don't allows remote comands `-noremote` and `-novncconnect`
- `-localhost` : allows only local connections works only local or over SSH
- `-o logfile` : defines location of the logfile
- `-bg` : Launches in Background

Autostart

In Lubuntu with LXDE add the following line to the file : `/etc/xdg/lxsession/Lubuntu/autostart`

Listing 60: /etc/xdg/lxsession/Lubuntu/autostart

```
@x11vnc -usepw -forever -display :0 -safer -bg -o /home/user/Documents/log/vnc/
↪x11vnc.log -localhost
```

In Lubuntu with lightdm add the following line to the file : `/etc/xdg/lxsession/Lubuntu/autostart`

Listing 61: /etc/xdg/lxsession/Lubuntu/autostart

```
@x11vnc -usepw -forever -safer -bg -o /home/user/Documents/log/vnc/x11vnc.log -
↪localhost -auth /var/run/lightdm/root/:0 -display :0
```

In Gnome add the following line to the file: `/etc/gdm/Init/Default`

Listing 62: /etc/gdm/Init/Default

```
x11vnc -usepw -forever -display :0 -safer -bg -o /home/zas/Documents/log/vnc/
↪x11vnc.log -localhost
```

VNC over SSH

Linux

Open SSH Tunnel

```
ssh -N -T -L 5900:localhost:5900 <hostname>
```

This forwards our local port `5900` to the host computers port `5900`, just replace `5900` with the port you normally use for VNC connections, i.e if you use display 20 then it would read `ssh -N -T -L 5920:<hostname>:5920`. The middle part is the hostname hostmachine, replace with the correct number for your network. The `-L` is the local port forward option while the `-N` option prevents a shell from opening so we cannot execute commands and the `-T` option disables pseudo-tty allocation.

Launch VNC Viewer in Linux

```
vncviewer localhost:5900
```

Windows

To connect to VNC over SSH in Linux you need a VNC Viewer like UltraVNC and Putty

Putty Config

see: os/linux/tools/x11vnc:Putty

Start VNC

- Start Putty with the above configuration
- Enter password
- Open a VNC Viewer
- Connect to `127.0.0.1`

Troubleshooting

If you have problems connecting to the remote machine, and if the connection gets rejected then you should quit your local VNC Server. Because you are connecting via localhost he might respond to your request.

Macintosh

Install Tools

Tightvnc is a great vncviewer and is installable through *Macport*, as well as Putty:

```
sudo port install tightvnc
sudo port install putty
```

Set up SSH Tunnel

Terminal

```
ssh -p <portnumber> -L 5900:127.0.0.1:5900 <hostname>
```

Putty

see: os/linux/tools/x11vnc:Putty

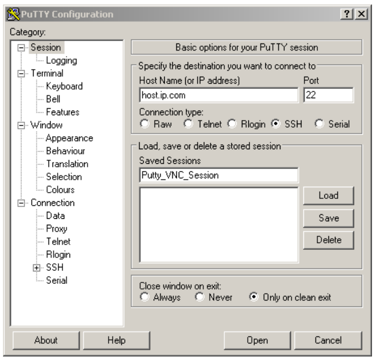
Launch VNC Viewer in Mac

```
vncviewer localhost:5900
```

or use the program “Chicken Of VNC”

Putty

- Create a new putty session
- goto Session -> Add hostname and port
- goto SSH -> Enable compression
- goto SSH -> Tunnels -> Add tunnel
  - Source Port: `5900`
  - Destination : `127.0.0.1:5900`
  - Click Add



Basic options for your PuTTY session

Specify the destination you want to connect to

Host Name (or IP address): host.ip.com

Port: 22

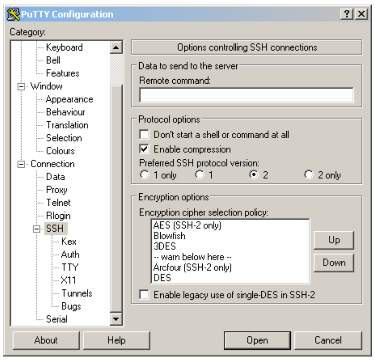
Connection type: ○ Raw ○ Telnet ○ Rlogin ● SSH ○ Serial

Load, save or delete a stored session

Saved Sessions: Putty_VNC_Session

Close window on exit: ○ Always ○ Never ● Only on clean exit

Figure3: Putty Session



Options controlling SSH connections

Data to send to the server

Remote command:

Protocol options

□ Don't start a shell or command at all

☑ Enable compression

Preferred SSH protocol version: ○ 1 only ○ 1 ● 2 ○ 2 only

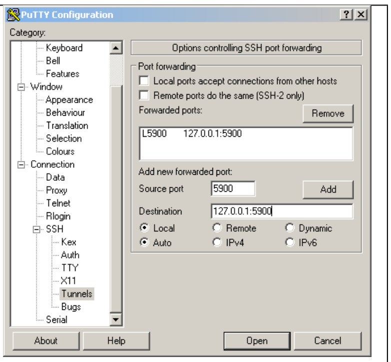
Encryption options

Encryption cipher selection policy:

AES (SSH-2 only)
Blowfish
3DES
-- warn below here --
Arcfour (SSH-2 only)
DES

□ Enable legacy use of single-DES in SSH-2

Figure4: Putty SHH Config



Options controlling SSH port forwarding

Port forwarding

□ Local ports accept connections from other hosts

□ Remote ports do the same (SSH-2 only)

Forwarded ports:

L5900 127.0.0.1:5900

Add new forwarded port:

Source port: 5900

Destination: 127.0.0.1:5900

● Local ○ Remote ○ Dynamic

● Auto ○ IPv4 ○ IPv6

Figure5: Putty Tunnel config

1.3.11 VPN Virtual Private Network

- *VPN Server Outgoing (Linux)*
  - *Install*
  - *Config*
  - *Start VPN*
  - *Enable Forwarding*
- *VPN client Incoming (Win 7)*

A virtual private network (VPN) extends a private network across a public network, such as the Internet. It enables a computer to send and receive data across shared or public networks as if it were directly connected to the private network, while benefiting from the functionality, security and management policies of the private network. This is done by establishing a virtual point-to-point connection through the use of dedicated connections, encryption, or a combination of the two.

There exist many different VPN protocols such as PPTP, OpenVPN, L2TP, SSTP. In this section We will set-up and connect a VPN connection using the PPTP protocol.

VPN Server Outgoing (Linux)

Install

```
sudo apt-get install pptpd
```

Config

Add the following lines in your `etc/pptpd.conf`

Listing 63: /etc/pptpd.conf

```
localip  192.168.1.5         # IP of your server hosting VPN
remoteip 192.168.1.234-1.238 # Range of IP to use for connected machines
```

Add the following lines to configure `pptpd` in `/etc/ppp/pptpd-options`

Listing 64: /etc/ppp/pptpd-options

```
ms-dns 192.168.1.1        # IP of your DNS Server
nobsdcomp
noipx
mtu 1490
mru 1490
```

add users to the `/etc/ppp/chap-secrets` file, you can add as many users as you like

Listing 65: /etc/ppp/chap-secrets

```
username * users-password *
```

Start VPN

Start / Restart the VPN Deamon to activate the config

```
sudo /etc/init.d/pptpd restart
```

Important: Note that the connection can only access the server itself and not beyond it. Enable forwarding to avoid this.

Enable Forwarding

This step is optional. It is needed to give the connected machine access beyond the server.

By enable forwarding the entire network will be available to the connected machine not just the VPN server itself.

Edit the `/etc/sysctl.conf` and change to following parameter from `0` to `1`

Listing 66: /etc/sysctl.conf

```
net.ipv4.ip_forward=1
```

To active the setting either restart the server or run the command:

```
sudo sysctl -p
```

VPN client Incoming (Win 7)

See the print screens to how to setup the VPN incoming connection on Windows 7.

Note: If VPN is setup by default to relay all traffic through the VPN connection. To avoid this you need to uncheck.

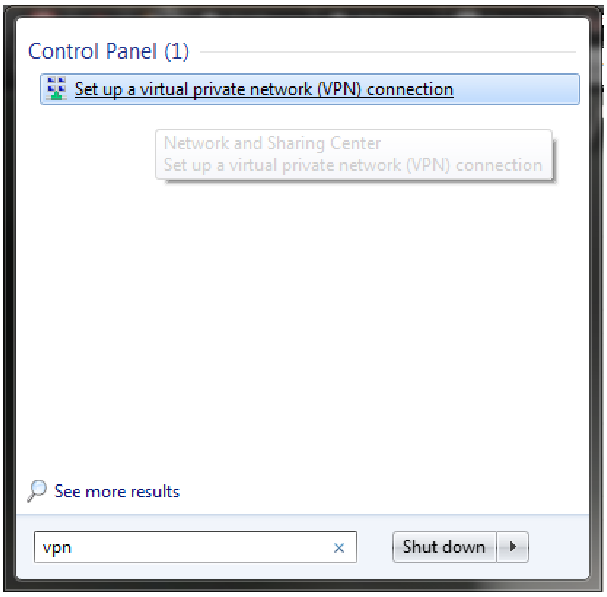
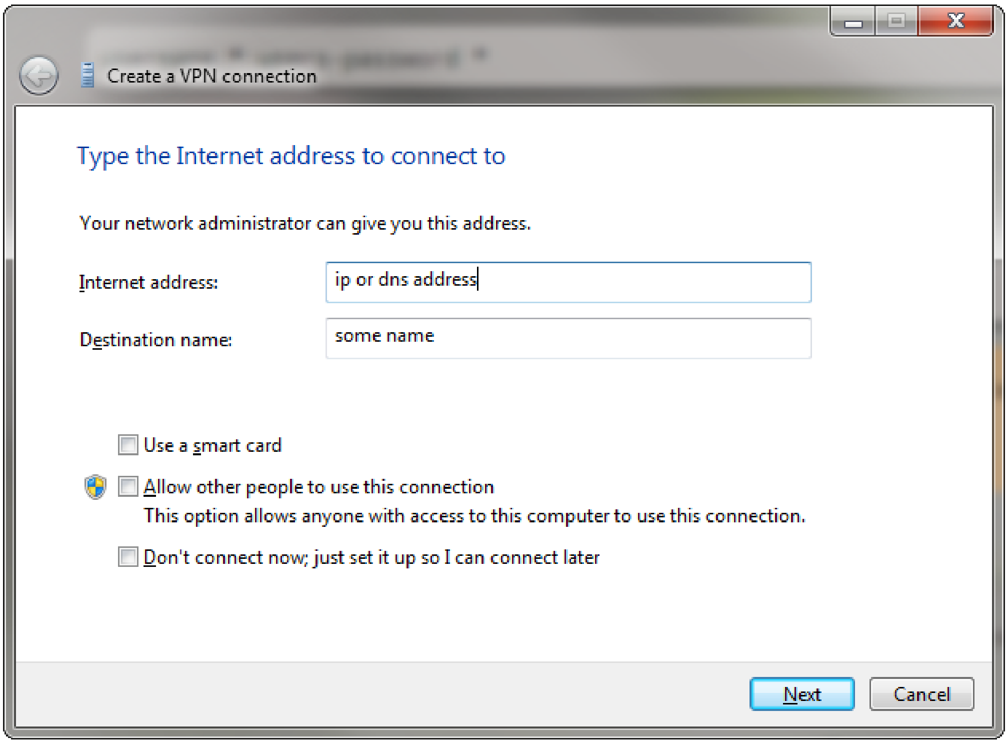

Control Panel (1)
Set up a virtual private network (VPN) connection
Network and Sharing Center
Set up a virtual private network (VPN) connection
See more results
vpn
Shut down

Figure6: Start VPN setup



Create a VPN connection

Type the Internet address to connect to

Your network administrator can give you this address.

Internet address: ip or dns address

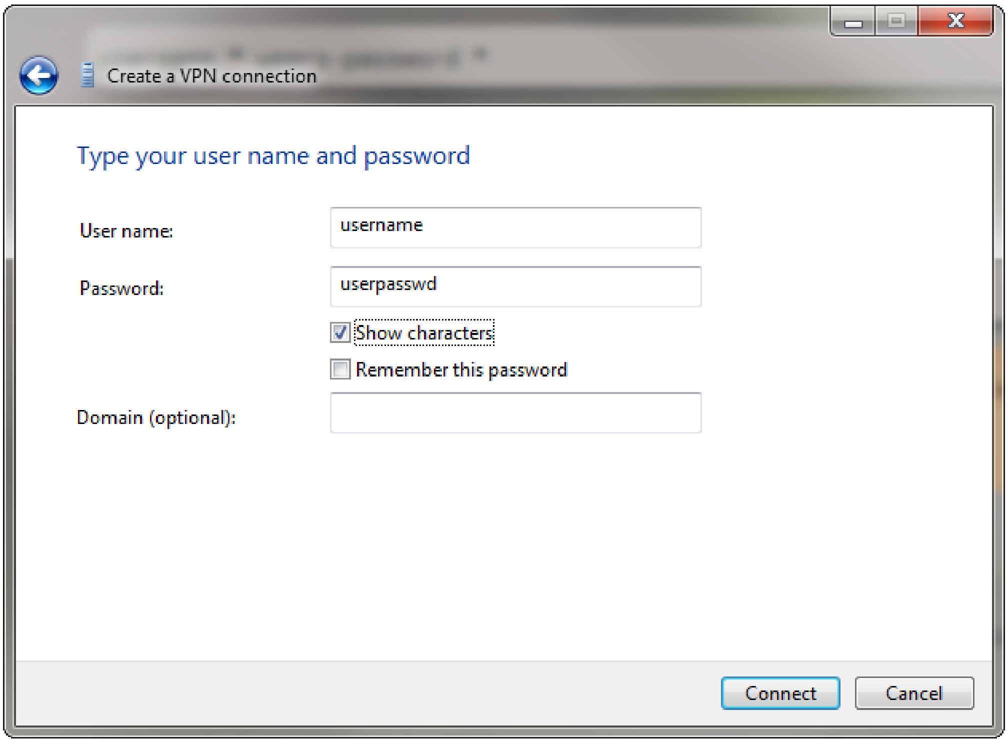
Destination name: some name

□ Use a smart card

□ Allow other people to use this connection
This option allows anyone with access to this computer to use this connection.

□ Don't connect now; just set it up so I can connect later

Figure7: Configure machine to connect to



Create a VPN connection

Type your user name and password

User name: username

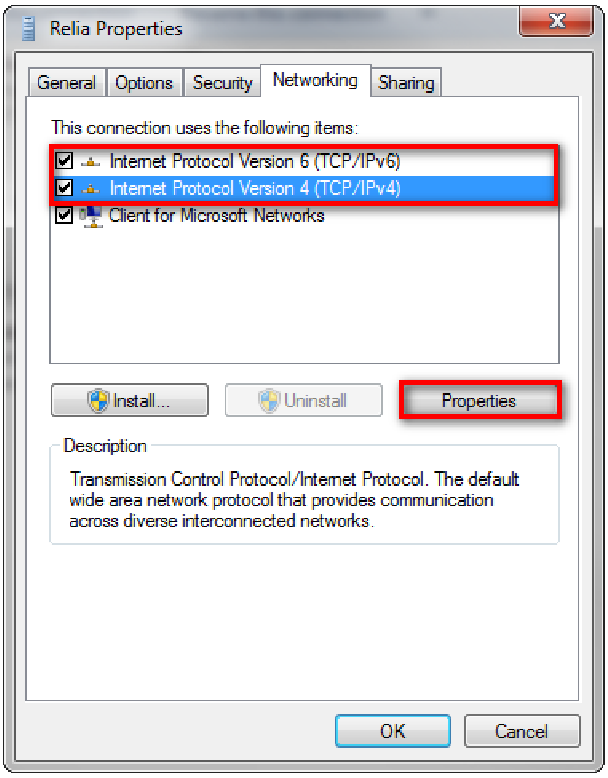
Password: userpasswd

☑ Show characters

□ Remember this password

Domain (optional):

Figure8: Configure user credentials



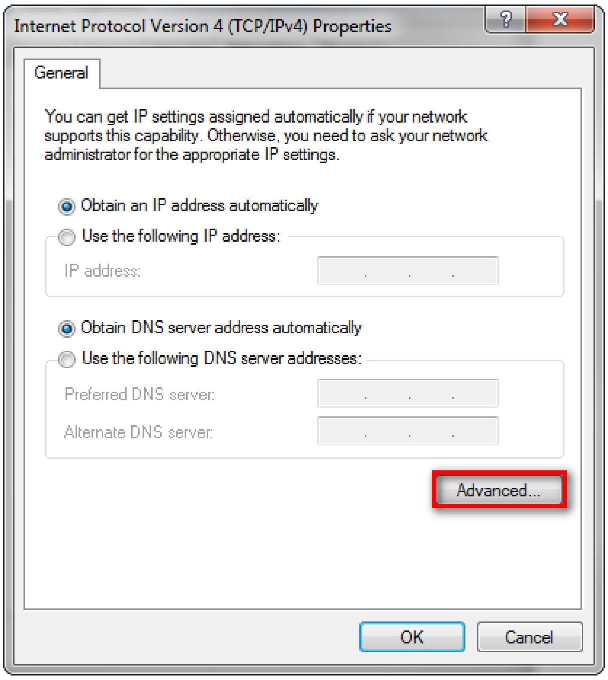
This connection uses the following items:

☑ Internet Protocol Version 6 (TCP/IPv6)
☑ Internet Protocol Version 4 (TCP/IPv4)
☑ Client for Microsoft Networks

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

Figure9: Change IPv4 and ipv6 properties

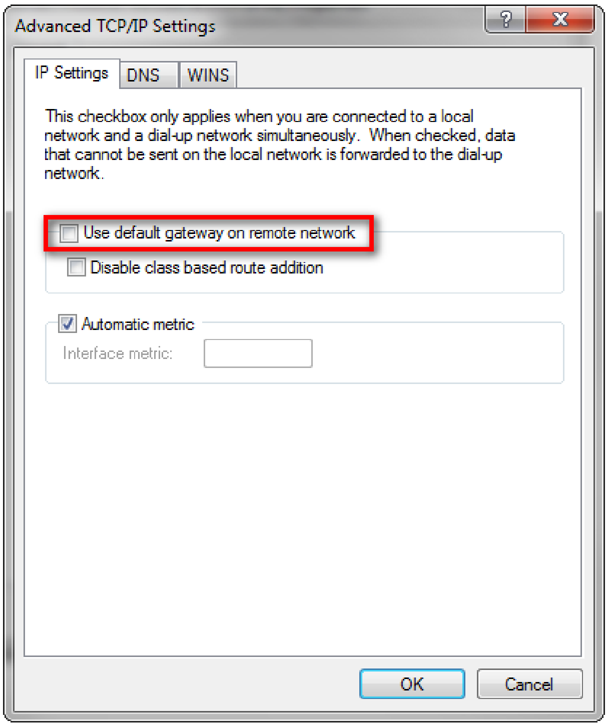


You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

● Obtain an IP address automatically
○ Use the following IP address:
IP address: . . .

● Obtain DNS server address automatically
○ Use the following DNS server addresses:
Preferred DNS server: . . .
Alternate DNS server: . . .

Figure10: Goto advanced properties



This checkbox only applies when you are connected to a local network and a dial-up network simultaneously. When checked, data that cannot be sent on the local network is forwarded to the dial-up network.

□ Use default gateway on remote network

□ Disable class based route addition

☑ Automatic metric

Interface metric:

Figure11: Uncheck user default gateway

1.4 Ubuntu

1.4.1 Installation and Config

- *Installation*
  - *Default Tools*
  - *ZSH*
  - *Oh My ZSH*
  - *SublimeText 3*
  - *SublimeMerge*
  - *Krusader*
  - *Yakuake*

  - *FSearch*
  - *Anaconda*
  - *QT-Creator*
  - *Visual Studio Code*
- *Configuration*
  - *Oh My ZSH Config*
  - *SublimeText 3 Config*
  - *SublimeMerge Config*
- *How To Use Ubuntu Tools*
  - *SSH*
    * *SSH connection without password*
    * *Open SSH Connection*
  - *VNC*
    * *Create password*
    * *Launch x11vnc*

Installation

This installation is based on Ubuntu 18.4 LTS and ROS Melodic Morenia.

Default Tools

```
sudo apt-get install git curl vim openssh-server krename rar unrar kget diffutils kate x11vnc
echo "Configure Firewall and Port for ssh"
sudo ufw allow ssh
sudo ufw enable
sudo ufw status
sudo service ssh restart
```

ZSH

```
sudo apt-get install zsh
sudo chsh -s /bin/zsh $USER
```

Oh My ZSH

```
cd ~/Downloads
sh -c "$(curl -fsSL https://raw.github.com/robbyrussell/oh-my-zsh/master/tools/
↪install.sh)"
```

SublimeText 3

```
wget -qO - https://download.sublimetext.com/sublimehq-pub.gpg | sudo apt-key add -
sudo apt-get install apt-transport-https
echo "deb https://download.sublimetext.com/ apt/stable/" | sudo tee /etc/apt/
↪sources.list.d/sublime-text.list
sudo apt-get update
sudo apt-get install sublime-text
```

SublimeMerge

```
wget -qO - https://download.sublimetext.com/sublimehq-pub.gpg | sudo apt-key add -
sudo apt-get install apt-transport-https
echo "deb https://download.sublimetext.com/ apt/stable/" | sudo tee /etc/apt/
↪sources.list.d/sublime-text.list
sudo apt-get update
sudo apt-get install sublime-merge
```

Krusader

```
sudo apt-get install krusader
```

Yakuake

```
sudo apt-get install yakuake
```

FSearch

```
sudo add-apt-repository ppa:christian-boxdoerfer/fsearch-daily
sudo apt update
sudo apt-get install fsearch-trunk
```

Anaconda

```
cd ~/Downloads
wget https://repo.anaconda.com/archive/Anaconda3-2019.10-Linux-x86_64.sh
bash Anaconda3-2019.10-Linux-x86_64.sh
```

QT-Creator

```
cd ~/Downloads
wget http://download.qt.io/official_releases/qt/5.13/5.13.1/qt-opensource-linux-
↪x64-5.13.1.run
chmod +x qt-opensource-linux-x64-5.13.1.run
./qt-opensource-linux-x64-5.13.1.run
sudo apt-get install build-essential
sudo apt-get install libfontconfig1
sudo apt-get install mesa-common-dev
sudo apt-get install libglu1-mesa-dev -y
```

Visual Studio Code

```
curl https://packages.microsoft.com/keys/microsoft.asc | gpg --dearmor > packages.
↪microsoft.gpg
sudo install -o root -g root -m 644 packages.microsoft.gpg /usr/share/keyrings/
sudo sh -c 'echo "deb [arch=amd64 signed-by=/usr/share/keyrings/packages.microsoft.
↪gpg] https://packages.microsoft.com/repos/vscode stable main" > /etc/apt/sources.
↪list.d/vscode.list'

sudo apt-get install apt-transport-https
sudo apt-get update
sudo apt-get install code # or code-insiders
```

Configuration

Oh My ZSH Config

Listing 67: ~/.zshrc additions

```
echo"#-----------------------------------------------------------------------------
↪-" >> ~/.zshrc
echo "# Program in Path" >> ~/.zshrc
echo "#" >> ~/.zshrc
echo "#----------------------------------------------------------------------------
↪--" >> ~/.zshrc
echo "# Special zsh config" >> ~/.zshrc
echo "# Show hidden files and folders" >> ~/.zshrc
echo "setopt globdots" >> ~/.zshrc
echo "#----------------------------------------------------------------------------
↪--" >> ~/.zshrc
echo "# Goto Alias" >> ~/.zshrc
echo "# Common home locations" >> ~/.zshrc
echo "alias home='cd ~'" >> ~/.zshrc
echo "alias root='cd /'" >> ~/.zshrc
echo "alias dtop='cd ~/Desktop'" >> ~/.zshrc
echo "alias dwld='cd ~/Downloads'" >> ~/.zshrc
```

(continues on next page)

(continued from previous page)

```
echo "alias docs='cd ~/Documents'" >> ~/.zshrc
echo "alias www='cd /var/www/html'" >> ~/.zshrc
echo "alias workspace='cd ~/Workspace'" >> ~/.zshrc
echo "alias aptlock-rm='sudo rm /var/lib/dpkg/lock && sudo rm /var/lib/dpkg/lock-
↪frontend'" >> ~/.zshrc
echo "# Common commands" >> ~/.zshrc
echo "alias o=open" >> ~/.zshrc
echo "alias ..='cd ..'" >> ~/.zshrc
echo "alias ...='cd ..; cd ..'" >> ~/.zshrc
echo "alias ....='cd ..; cd ..; cd ..'" >> ~/.zshrc
echo "# Common command shortcuts" >> ~/.zshrc
echo "alias cls=clear" >> ~/.zshrc
echo "alias ll='ls -la'" >> ~/.zshrc
```

SublimeText 3 Config

Listing 68: ~/.zshrc additions

```
echo "# Sublime Text" >> ~/.zshrc
echo "export PATH=$PATH:/opt/sublime_text" >> ~/.zshrc

echo "# Sublime Text" >> ~/.bashrc
echo "export PATH=$PATH:/opt/sublime_text" >> ~/.bashrc

cp ./../config/sublimetext/Package Control.sublime-settings ~/.config/sublime-text-
↪3/Packages/User/
```

SublimeMerge Config

Listing 69: ~/.zshrc additions

```
echo "#Sublime Merge" >> ~/.zshrc
echo "export PATH=$PATH:/opt/sublime_merge" >> ~/.zshrc

echo "#Sublime Merge" >> ~/.bashrc
echo "export PATH=$PATH:/opt/sublime_merge" >> ~/.bashrc
```

How To Use Ubuntu Tools

SSH

SSH connection without password

```
# On your local machine generate a RSA Key pair
ssh-keygen -t rsa

# Copy your local public key to the remote machine safely
ssh-copy-id -i ~/.ssh/id_rsa.pub "<user>@<remoteip> -p <portnumber>"
# OR
scp id_rsa.pub <user>@<remoteip>:~/.ssh/machine.pub

# Append key to file authorized_keys
cat ~/.ssh/*.pub | ssh <user>@<remoteip> -p <portnumber> 'umask 077; cat >>.ssh/
↪authorized_keys'
```

(continues on next page)

(continued from previous page)

Open SSH Connection

```
# Just ssh
ssh <user>@<remoteip>

# ssh with portforwarding
ssh -L <local-port>:localhost:<remote-port> <user>@<remoteip>
# ssh with vnc port forwarding
ssh -L 5900:localhost:5900 spl@<remoteip>
```

VNC

On remote PC x11vnc needs to be installed and launched. Prefereable add to startup commands

Create password

Only needed if not only localhost used.

```
x11vnc -storepasswd
```

Launch x11vnc

```
# Command with all options
x11vnc -usepw -forever -display :0 -safer -bg -o ~/Documents/log/vnc/x11vnc.log -
↪localhost

# Minimal command but still restricted to localhost
x11vnc -forever -display :0 -safer -bg -localhost
```

1.4.2 Introduction

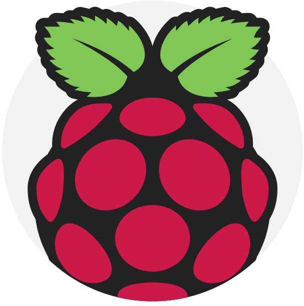
- *Additional Informations*

Additional Informations

- https://ubuntu.com/ - Ubuntu Webpage
  - https://ubuntu.com/#download - Ubuntu Download
- https://www.osboxes.org/ubuntu/ - Virtual Box images
- Additional Tools
  - ZSH
    - Oh My ZSH

- Sublime Text
- Sublime Merge
- Krusader
- Yakuake
- FSearch
- Anaconda
- QT Creator
- Visual Studio Code
- Hitachi SDK
  - Hitachi LiDaR SDK
  - Hitachi LiDaR ROS Driver
- ROS Installation

1.5 Raspberry Pi



1.5.1 Rune Audio

- *Commandline Tricks*
- *Hifiberry Amp+*

Rune Audio is a based on an Archlinux distribution. It is intended to be easy to setup and offers a wide variety of audio tools and supports many different DAC’s. For the Raspberry Pi A+/B+ and 2 a preconfigured image is available with out of the box support for many DAC’s.

Features are:

- Webserver
- MPD

- Shairport (Airplay)
- Webradio
- USB
- Samba
- Jamendo
- Spotify
- DLNA

Commandline Tricks

Listing 70: soundcards and attached boards

```
aplay -l # Display's available sound cards
aplay -L # Display's all PCM's
```

Listing 71: volume mixer

```
amixer sset Master 100 #   ~0% Volume
amixer sset Master 200 # ~100% Volume
```

Hifiberry Amp+

Add HiFiberry Amp+ to the system. First you need to add the devicetree overlay.

Listing 72: /boot/config.txt>

```
device_tree_overlay=hifiberry-amp
```

Afterwards you need to change the mpd configuration.

Listing 73: /etc/mpd.conf

```
audio_output {
        name            "snd_rpi_hifiberry_amp"
        type            "alsa"
        device          "hw:1,0"
        mixer_type      "hardware"
        mixer_control   "Master"
        mixer_device    "hw:1"
        mixer_index     "0"
        auto_resample   "no"
        auto_format     "no"
        enabled         "yes"
}
```

Perhaps the file `/etc/mpd.conf` will be overwritten on each restart. As a bad fix this can be avoided making the file immutable

```
chattr +i /etc/mpd.conf
```

1.5.2 Setup Rpi

- *Raspi-conf*
- *Wifi Dongle*
  - *Setup*
  - *For static IP address*
- *Disable Power saving mode*
- *SSH*
  - *Set up Hostname*
  - *SSH Connect*
    - *Resolve ssh lang issue*
    - *Source `.bashrc` file upon ssh logon*
- *GUI*
- *Important stuff*
- *Interconectivity*
- *Python modules*
  - *General*
  - *GPIO*
  - *I2C*

Raspi-conf

The integrated Rpi config tool for many things.

```
raspi-config
```

Wifi Dongle

Setup

Listing 74: /etc/network/interfaces

```
auto lo

iface lo inet loopback
iface eth0 inet dhcp

allow-hotplug wlan0
auto wlan0


iface wlan0 inet dhcp
        wpa-ssid "ssid"
        wpa-psk "password"
```

For static IP address

Listing 75: /etc/network/interfaces

```
iface eth0 inet static
address <static-ip>
netmask 255.255.255.0
network 192.168.0.0
broadcast 192.168.0.255
gateway 192.168.0.1
```

Disable Power saving mode

Listing 76: /etc/modprobe.d/8192cu.conf

```
# Disable power saving
options 8192cu rtw_power_mgnt=0 rtw_enusbss=1 rtw_ips_mode=1
```

SSH

See also *SSH*

Set up Hostname

Setting up your Raspberry with a hostname can be very useful if it is connected to a network with DHCP Server. Instead of searching for the IP of the RPi you can find it by it's hostname.

- install samba and the samba tools

```
sudo apt-get install samba samba-common-bin
sudo apt-get install netatalk # for avahi setup for mac
```

- change the hostname in the following files

```
sudo vim /etc/hostname
sudo vim /etc/hosts
# or
sudo hostname <new_host_name>
```

- restart hostname service

```
sudo service hostname.sh start
```

Now you can connect to your RPi with your hostname

SSH Connect

Regenerate ssh keys to be safe

```
rm /etc/ssh/ssh_host_* && dpkg-reconfigure openssh-server
```

Connect via remote PC

```
ssh pi@<hostname>
# or for mac
ssh <hostname>.local -l <username>
```

Resolve ssh lang issue

Listing 77: /etc/ssh/ssh_config

```
# Comment the following line
# SendEnv LANG LC...
```

Add the following environment variables into your ~/.bash_profile

Listing 78: ~/.bash_profile

```
export LANG="en_US"
export LANGUAGE=$LANG
export LC_ALL=$LANG
```

Source .bashrc file upon ssh logon

Add the following line to the ~/.bash_profile

Listing 79: ~/.bash_profile

```
source $HOME/.bashrc
```

GUI

Launch GUI

```
startx
```

Important stuff

```
sudo apt-get install vim git tightvncserver
```

Interconectivity

Enable i2c

Listing 80: /etc/modules

```
i2c-bcm2708
i2c-dev
```

Remove SPI and I2C from the blacklist

Listing 81: /etc/modprobe.d/raspi.blacklist.conf

```
# Comment out both line to remove from blacklist
# blacklist spi-bcm2708
# blacklist i2c-bcm2708
```

Python modules

General

```
sudo apt-get install python-dev
```

GPIO

```
sudo apt-get install python-rpi.gpio # GPIO Module
```

I2C

```
sudo apt-get install python-smbus # SMBus support
sudo apt-get install i2c-tools    # I2C support
sudo i2cdetect -y 0               # Detect I2C on RPi v2
```

1.6 Filesystem

1.6.1 Important Files

```
/boot/grub             # Grub files
/etc/fstab             # Drive mounts
/etc/profile           # EnvVar for all users
/etc/group             # All groups available
/home/username/.bashrc # User-script @startup
/etc/init.d/           # Global start-scripts
/etc/ssh/sshd.config   # SSH config file
~.bashrc               # bash shell init scripts
~.zshrc                # zsh shell init scripts
```

1.6.2 Folders

Foreword

Like UNIX, Linux chooses to have a single hierarchical directory structure.

Everything starts from the root directory, represented by /, and then expands into sub-directories instead of having so-called 'drives'. In the Windows environment, one may put one's files almost anywhere: on C drive, D drive, E drive etc. Such a file system is called a hierarchical structure and is managed by the programs themselves (program directories), not by the operating system. On the other hand, Linux sorts directories descending from the root directory / according to their importance to the boot process.

Root directory /

As we all know Linux file system starts with /, the root directory. All other directories are 'children' of this directory. The partition which the root file system resides on is mounted first during boot and the system will not boot if it doesn't find it. On our reference system, the root directory contains the following sub-directories:

Folder	Description
/bin	Essential command binaries
/boot	Static files of the boot loader
/dev	Device files
/etc	Host-specific system configuration
/root	Home directory for the root user (optional)
/home	User home directories (optional)
/lib	Essential shared libraries and kernel modules
/lib<qual>	Alternate format essential shared libraries (optional)
/media	Mount point for removeable media
/mnt	Mount point for mounting a filesystem temporarily
/opt	Add-on application software packages
/sbin	Essential system binaries
/srv	Data for services provided by this system
/tmp	Temporary files
/usr	Secondary hierarchy
/var	Variable data

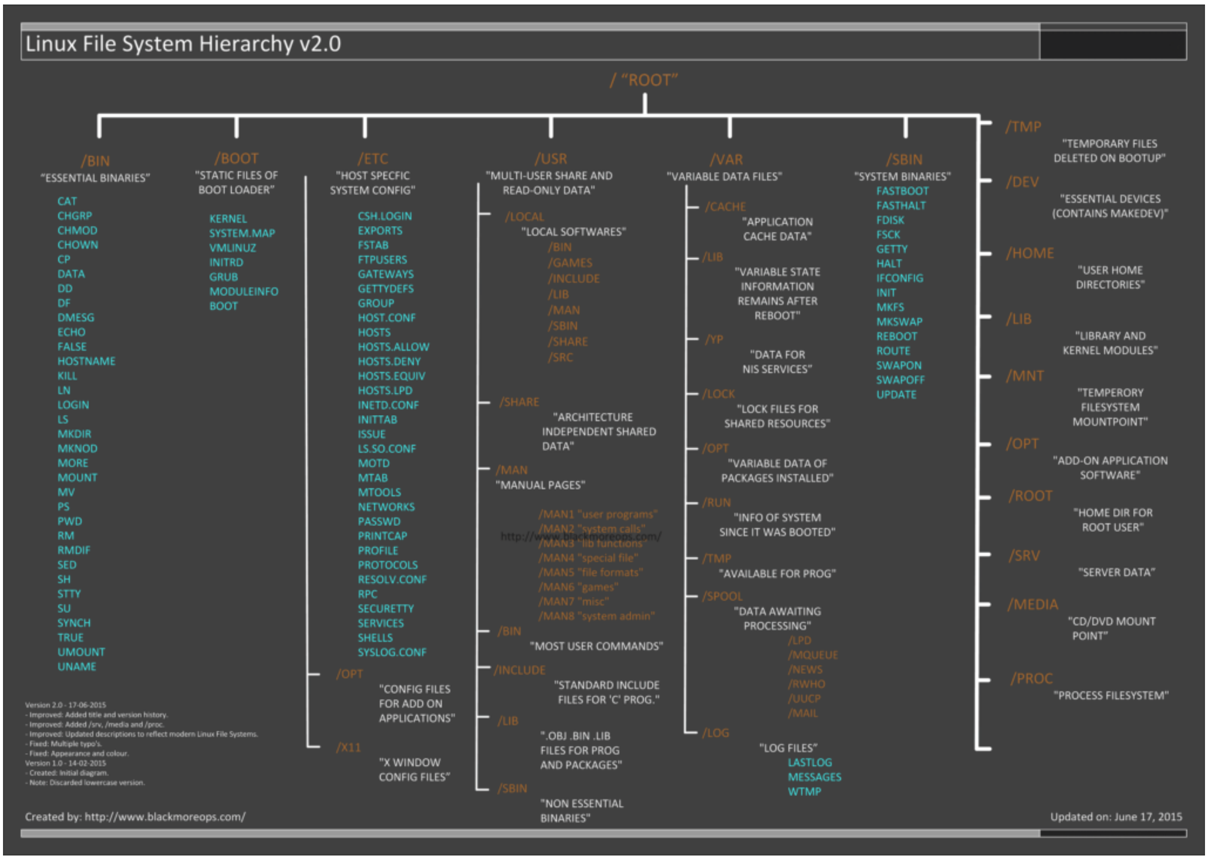


Figure12: https://www.blackmoreops.com/

/bin

The bin directory contains several useful commands that are of use to both the system administrator as well as non-privileged users. It usually contains the shells like bash, csh, etc. and commonly used commands like cp, mv, rm, cat, ls. For this reason and in contrast to `/usr/bin`, the binaries in this directory are considered to be essential. The reason for this is that it contains essential system programs that must be available even if only the partition containing / is mounted. This situation may arise should you need to repair other partitions but have no access to shared directories (ie. you are in single user mode and hence have no network access). It also contains programs which boot scripts may depend on.

/boot

This directory contains everything required for the boot process except for configuration files not needed at boot time (the most notable of those being those that belong to the GRUB boot-loader) and the map installer. Thus, the `/boot` directory stores data that is used before the kernel begins executing user-mode programs. This may include redundant (back-up) master boot records, sector/system map files, the kernel and other important boot files and data that is not directly edited by hand. Programs necessary to arrange for the boot loader to be able to boot a file are placed in `/sbin`. Configuration files for boot loaders are placed in `/etc`. The system kernel is located in either / or `/boot` (or as under Debian in `/boot` but is actually a symbolically linked at `/`.

/boot/map

Contains the location of the kernel.

/boot/vmlinuz /boot/vmlinuz-kernel-version

Normally the kernel or symbolic link to the kernel.

/boot/grub

This subdirectory contains the GRUB configuration files including boot-up images and sounds. GRUB is the GNU GRand Unified Bootloader, a project which intends to solve all bootup problems once and for all. One of the most interesting features, is that you don't have to install a new partition or kernel, you can change all parameters at boot time via the GRUB Console, since it knows about the filesystems.

/boot/grub/grub.conf /boot/grub/menu.lst

Grub configuration file.

/dev

`/dev` is the location of special or device files. It is a very interesting directory that highlights one important aspect of the Linux filesystem - everything is a file or a directory. Look through this directory and you should hopefully see hda1, hda2 etc.... which represent the various partitions on the first master drive of the system. `/dev/cdrom` and `/dev/fd0` represent your CD-ROM drive and your floppy drive. This may seem strange but it will make sense if you compare the characteristics of files to that of your hardware. Both can be read from and written to. Take `/dev/dsp`, for instance. This file represents your speaker device. Any data written to this file will be re-directed to your speaker. If you try `cat /boot/vmlinuz > /dev/dsp` (on a properly configured system) you should hear some sound on the speaker. That's the sound of your kernel! A file sent to `/dev/lp0` gets printed. Sending data to and reading from `/dev/ttyS0` will allow you to communicate with a device attached there - for instance, your modem.

3 Informations are relevant:

- Kind of the Access
  - bloc oriented (b) - buffered access e.g. Harddisks
  - characteroriented (c) - non buffered access e.g. Screen, Printer
- Major device number
  - Specify the driver to be used.
- Minor device number
  - To describe the actual instance of a device. In case multiple devices of the same driver are used

Some common device files as well as their equivalent counterparts under Windows that you may wish to remember are:

Listing 82: deviceslist.txt

```
/dev/ttyS0 (First communications port, COM1)
    First serial port (mice, modems).

/dev/psaux (PS/2)
    PS/2 mouse connection (mice, keyboards).

/dev/lp0 (First printer port, LPT1)
    First parallel port (printers, scanners, etc).

/dev/dsp (First audio device)
    The name DSP comes from the term digital signal processor, a specialized␣
↪processor chip optimized for digital signal analysis. Sound cards may use a␣
↪dedicated DSP chip, or may implement the functions with a number of discrete␣
↪devices. Other terms that may be used for this device are digitized voice and␣
↪PCM.

/dev/usb (USB Devices)
    This subdirectory contains most of the USB device nodes. Device name␣
↪allocations are fairly simplistic so no elaboration is be necessary.

/dev/sda (C:\, SCSI device)
    First SCSI device (HDD, Memory Sticks, external mass storage devices such as␣
↪CD-ROM drives on laptops, etc).

/dev/scd (D:\, SCSI CD-ROM device)
    First SCSI CD-ROM device.

/dev/js0 (Standard gameport joystick)
    First joystick device.

/dev/hd*
    Mounted Harddisk Partitions
```

/etc

Contains all local configurationfiles.

/root

Home folder for the root user. In most systems it was eliminated

/home

Home folder for all system users. Each user has a own RWX folder with his name inside /home/

`/lib`

Needed systemlibraries and kernelmodules

`/lib<qual>`

Needed systemlibraries and kernelmodules

`/media`

Debian automatic mountpoint for Plug&Play programms

`/mnt`

Temporary mountpoint

`/opt`

Place for optional Software installed be the user.

`/sbin`

Important systemprogramms. They are used for the startup of the system. Only executable by root user.

`/tmp`

All users can use this foder to store temporary files

`/usr`

User Data

`/var`

Variable data

Chapter 2

Mac

2.1 Geektool

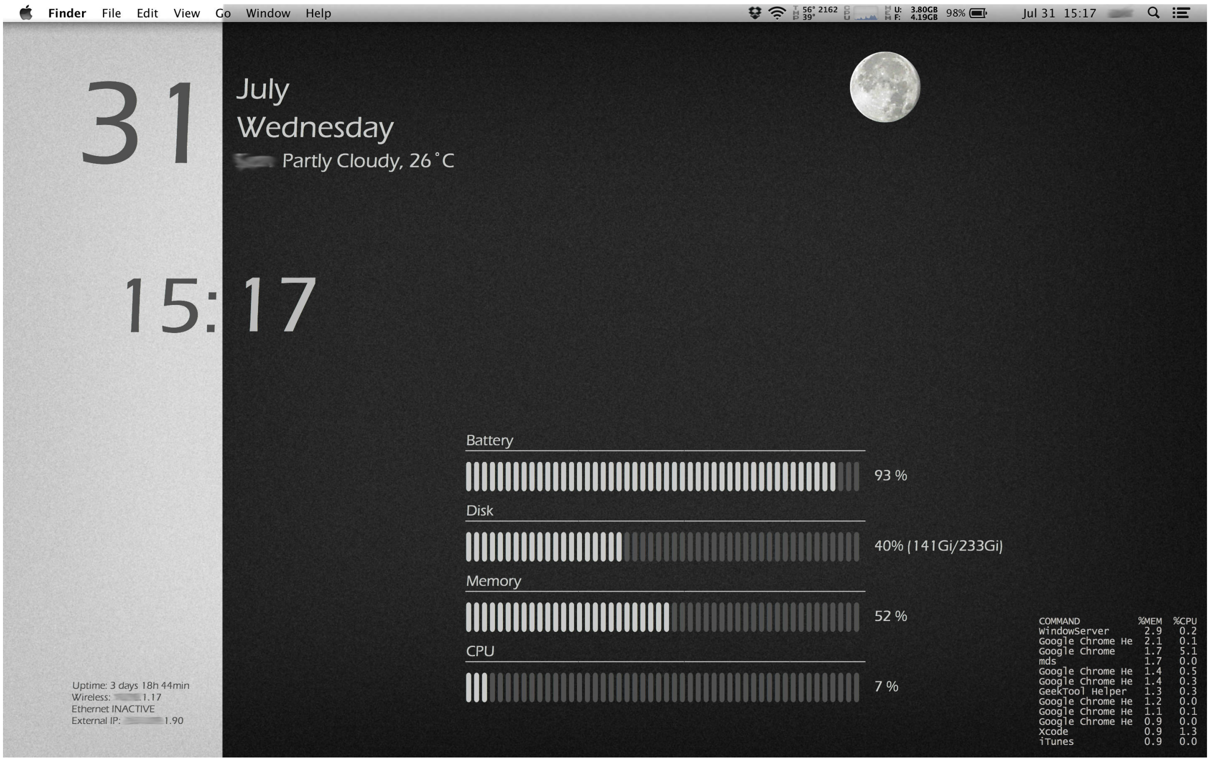
Geektool is a wonderful program to display information on your desktop. Here you can see my “Control Center”.

2.1.1 Date & Time

All command geeklets

```
date +%d                # Day number
date +%B                # Month
date +%A                # Weekday
```

```
date "+%H"              # Hour
date "+%M"              # Minutes
```



31

July
Wednesday
[redacted] Partly Cloudy, 26˚C

15:17

Battery 93 %
Disk 40% (141Gi/233Gi)
Memory 52 %
CPU 7 %

Uptime: 3 days 18h 44min
Wireless: [redacted]1.17
Ethernet INACTIVE
External IP: [redacted]1.90

```
COMMAND              %MEM   %CPU
WindowServer          2.9    0.2
Google Chrome He      2.1    0.1
Google Chrome         1.7    5.1
mds                   1.7    0.0
Google Chrome He      1.4    0.5
Google Chrome He      1.4    0.3
GeekTool Helper       1.3    0.3
Google Chrome He      1.2    0.0
Google Chrome He      1.1    0.1
Google Chrome He      0.9    0.0
Xcode                 0.9    1.3
iTunes                0.9    0.0
```

Figure1: Geektool Example

2.1.2 Location & Weather

Actual Weather

All command geeklets Get the weather of a certain location from Yahoo weather.

```
WEATHER=`curl --silent "http://weather.yahooapis.com/forecastrss?p=SZXX0035&u=c" | ␣
↪grep -E '(Current Conditions:|C<BR)' | tail -n1 | sed -e 's/<BR \/>//' -e 's/ C$/
↪˚C/'`
echo "Sion " $WEATHER
```

Moonphase

Get the image for the actual Moonphase from lexiyoga. Directly the image will be fetch, therefore a image geeklet is needed.

```
http://www.lexiyoga.com/images/moon/moon16.png
```

2.1.3 System information

Uptime

```
uptime | awk '{sub(/[0-9]|user\,|users\,|load/, "", $6); sub(/mins,|min,/, "min", $6); sub(/user\,|users\,/, "", $5); sub(",", "min", $5); sub(":", "h ", $5); sub(/[0-9]/, "", $4); sub(/day,/, " day ", $4); sub(/days,/, " days ", $4); sub(/mins,|min,/, "min", $4); sub("hrs,", "h", $4); sub(":", "h ", $3); sub(",", "min", $3); print "Uptime: " $3$4$5$6}'
```

Networking

```
# Internal Wireless IP
myen0=`ifconfig en0 | grep "inet " | grep -v 127.0.0.1 | awk '{print $2}'`
if [ "$myen0" != "" ]
then
echo "Wireless: $myen0"
else
echo "Wireless INACTIVE"
fi

# Internal Ethernet IP
myen1=`ifconfig en1 | grep "inet " | grep -v 127.0.0.1 | awk '{print $2}'`
if [ "$myen1" != "" ]
then
echo "Ethernet: $myen1"
else
echo "Ethernet INACTIVE"
fi

# External IP
wip=`curl --silent http://checkip.dyndns.org | awk '{print $6}' | cut -f 1 -d "<"`
echo "External IP: $wip"
```

Battery status

```
BATTERY=`ioreg -l | awk '$3~/Capacity/{c[$3]=$5}END{OFMT="%.f %%";max=c["\"MaxCapacity\""];print(max>0?100*c["\"CurrentCapacity\""]/max:"?")}'`
echo $BATTERY '\n\n\n'
```

HDD usage

```
DISK=`df -hl | grep 'disk0s2' | awk '{print $5 "  ("$4"/"$2")"}'`
echo $DISK '\n\n\n'
```

Ram usage

```
MEM=`top -l 1 | grep PhysMem: | awk '{print int($2/($2+$6)*100)}'`
echo $MEM'%\n\n\n'
```

CPU load

```
SYSTEM=`top -l3 | grep "CPU usage" | tail -1 | awk '{print int(($3+$5))}' | sed 's/
↪\%//'`
echo $SYSTEM '%\n\n\n'
```

Process manager

```
ps -amcwwwxo "command %mem %cpu" | grep -v grep | head -13
```

2.2 Keyboard Layout

All Mac have a keyboard were many symbols are missing. In programming this is very unpractical, so either you know on the tip of your head where which symbol is; or you look at the layout below ;-).

The layout is accordingly to the Mac Retina Book Swiss keyboard.

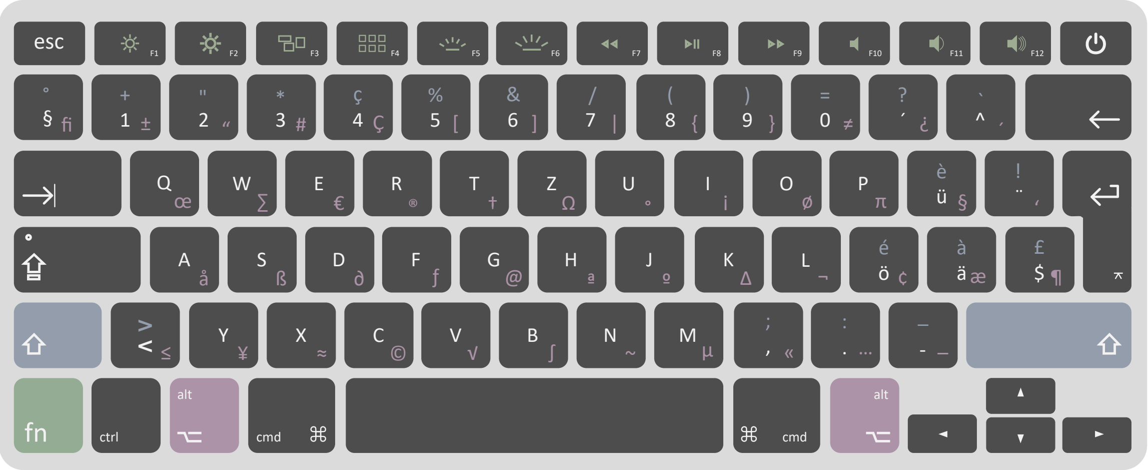


Figure2: Mac keyboard swiss layout

2.3 Macport

https://www.macports.org

```
sudo port install <programname>
sudo port uninstall <programname>

port list

port info <programname>
```

2.3.1 Useful Macports

- Krusader
- kdiff3
- md5deep
- unrar
- pzip
- putty
- tightvnc
- …

Chapter 3

Windows

3.1 Firewall

- *SSH Over FTP Port*

3.1.1 SSH Over FTP Port

Ff FTP Port is used for SSH connections disable `Statefulftp` in the Windows firewall

```
netsh advfirewall set global statefulftp disable
```

3.2 Group Policies

- *Modify Policies*
- *See all modified Group Policies*

3.2.1 Modify Policies

Search for `Edit group policy`

3.2.2 See all modified Group Policies

Search for `rsop.msc`

3.3 Registry

- *Login*
- *DateTime*
- *Shell Overlay Icons*
- *Context Menu*
- *New Context Menu*
- *SAP Shortcut Password*
- *PowerPoint Options*

3.3.1 Login

```
Computer\HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon
```

3.3.2 DateTime

```
HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\DateTime\Servers
```

3.3.3 Shell Overlay Icons

```
Computer\HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Explorer\
↪ShellIconOverlayIdentifiers
```

3.3.4 Context Menu

```
Computer\HKEY_CLASSES_ROOT\*\shellex\ContextMenuHandlers
```

3.3.5 New Context Menu

```
Computer\HKEY_CLASSES_ROOT\
```

3.3.6 SAP Shortcut Password

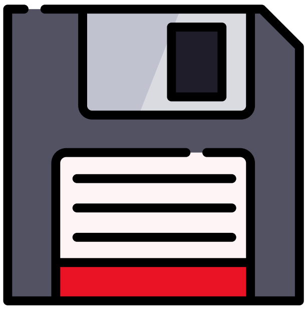
```
Computer\HKEY_CURRENT_USER\Software\SAP\SAPShortcut\Security
```

3.3.7 PowerPoint Options

```
Computer\HKEY_CURRENT_USER\Software\Microsoft\Office\16.0\PowerPoint\Options
  * ExportBitmapResolution => DWORD 32bit => 300 (ppi)
  * AutomaticPicturesCompressionDefault => DWORD => 0
```

Chapter 4

Useful Tools



Quick unfinished List of useful tools

4.1 Multimedia

- VLC - Video Player 🐧 🍎 ⊞
- Gimp - Image Editor 🐧 🍎 ⊞
- Inkscape - Vector Graphic Editor 🐧 🍎 ⊞
- pdftk 🐧 🍎 ⊞
- PlantUML 🐧 🍎 ⊞
- Graphviz 🐧 🍎 ⊞
- Wavedrom 🐧 🍎 ⊞
- *Latex* 🐧 🍎 ⊞

4.2 Internet

- Madsonic 🐧
- X11VNC 🐧

4.3 Commandline

- Yakuake 🐧
- Total Terminal 🍎
- Cmder ⊞

4.4 Managment

- Total Commander ⊞
- Krusader 🐧
- DCommander 🍎
- Hyperdock 🍎
- iStat Menu 🍎
- Virtualbox 🐧 🍎 ⊞
- Keepass 🐧 🍎 ⊞

4.5 Programming

- Sublime Text 🐧 🍎 ⊞
- Sublime Merge 🐧 🍎 ⊞
- git 🐧 🍎 ⊞
- Mentor HDL Designer 🐧 ⊞
- Mentor Modelsim 🐧 ⊞
- Xilinx ISE 🐧 ⊞
- Intel Quartus ⊞
- Intellij IDEA 🐧 🍎 ⊞

- Intellij PyCharm 🐧 🍎 🪟
- Jupyterlab 🐧 🍎 🪟
- SpinalHDL 🐧 🍎 🪟

Chapter 5

Git

5.1 Git Commands

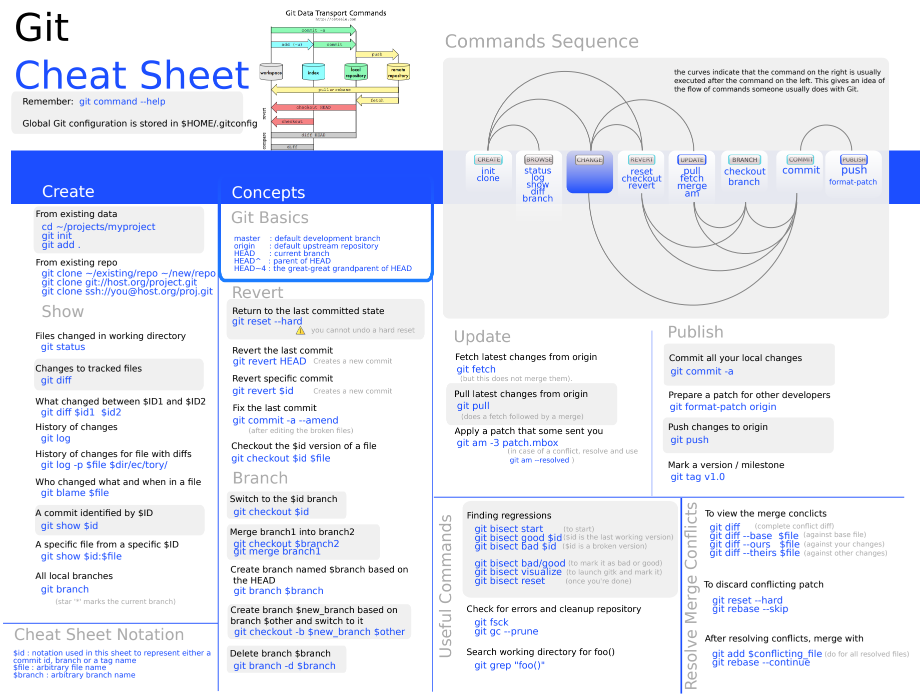
- *Start a working area*
- *Work on the current change*
- *Examine the history and state*
- *Grow, mark and tweak your common history*
- *Collaborate*

5.1.1 Start a working area

Command	Description
`clone`	Clone a repository into a new directory
`init`	Create an empty Git repository or reinitialize an existing one

5.1.2 Work on the current change

Command	Description
`add`	Add file contents to the index
`mv`	Move or rename a file, a directory, or a symlink
`reset`	Reset current HEAD to the specified state
`rm`	Remove files from the working tree and from the index



Git
Cheat Sheet

Remember: git command --help

Global Git configuration is stored in $HOME/.gitconfig

Git Data Transport Commands
http://osteele.com
commit -a
add (-u)
commit
push
workspace
index
local repository
remote repository
pull or rebase
fetch
checkout HEAD
checkout
revert
diff HEAD
diff
compare

Commands Sequence

the curves indicate that the command on the right is usually executed after the command on the left. This gives an idea of the flow of commands someone usually does with Git.

CREATE
init
clone
BROWSE
status
log
show
diff
branch
CHANGE
REVERT
reset
checkout
revert
UPDATE
pull
fetch
merge
am
BRANCH
checkout
branch
COMMIT
commit
PUBLISH
push
format-patch

Create

From existing data
cd ~/projects/myproject
git init
git add .

From existing repo
git clone ~/existing/repo ~/new/repo
git clone git://host.org/project.git
git clone ssh://you@host.org/proj.git

Show

Files changed in working directory
git status

Changes to tracked files
git diff

What changed between $ID1 and $ID2
git diff $id1 $id2

History of changes
git log

History of changes for file with diffs
git log -p $file $dir/ec/tory/

Who changed what and when in a file
git blame $file

A commit identified by $ID
git show $id

A specific file from a specific $ID
git show $id:$file

All local branches
git branch
(star '*' marks the current branch)

Cheat Sheet Notation

$id : notation used in this sheet to represent either a commit id, branch or a tag name
$file : arbitrary file name
$branch : arbitrary branch name

Concepts

Git Basics

master : default development branch
origin : default upstream repository
HEAD : current branch
HEAD^ : parent of HEAD
HEAD~4 : the great-great grandparent of HEAD

Revert

Return to the last committed state
git reset --hard
⚠ you cannot undo a hard reset

Revert the last commit
git revert HEAD Creates a new commit

Revert specific commit
git revert $id Creates a new commit

Fix the last commit
git commit -a --amend
(after editing the broken files)

Checkout the $id version of a file
git checkout $id $file

Branch

Switch to the $id branch
git checkout $id

Merge branch1 into branch2
git checkout $branch2
git merge branch1

Create branch named $branch based on the HEAD
git branch $branch

Create branch $new_branch based on branch $other and switch to it
git checkout -b $new_branch $other

Delete branch $branch
git branch -d $branch

Update

Fetch latest changes from origin
git fetch
(but this does not merge them).

Pull latest changes from origin
git pull
(does a fetch followed by a merge)

Apply a patch that some sent you
git am -3 patch.mbox
(in case of a conflict, resolve and use git am --resolved)

Publish

Commit all your local changes
git commit -a

Prepare a patch for other developers
git format-patch origin

Push changes to origin
git push

Mark a version / milestone
git tag v1.0

Useful Commands

Finding regressions
git bisect start (to start)
git bisect good $id ($id is the last working version)
git bisect bad $id ($id is a broken version)

git bisect bad/good (to mark it as bad or good)
git bisect visualize (to launch gitk and mark it)
git bisect reset (once you're done)

Check for errors and cleanup repository
git fsck
git gc --prune

Search working directory for foo()
git grep "foo()"

Resolve Merge Conflicts

To view the merge conclicts
git diff (complete conflict diff)
git diff --base $file (against base file)
git diff --ours $file (against your changes)
git diff --theirs $file (against other changes)

To discard conflicting patch
git reset --hard
git rebase --skip

After resolving conflicts, merge with
git add $conflicting_file (do for all resolved files)
git rebase --continue

Figure1: Git Cheatsheet

5.1.3 Examine the history and state

Command	Description
`log`	Show commit logs
`show`	Show various types of objects
`status`	Show the working tree status

5.1.4 Grow, mark and tweak your common history

Command	Description
`branch`	List, create, or delete branches
`checkout`	Switch branches or restore working tree files
`commit`	Record changes to the repository
`diff`	Show changes between commits, commit and working tree, etc
`merge`	Join two or more development histories together
`rebase`	Reapply commits on top of another base tip
`tag`	Create, list, delete or verify a tag object signed with GPG

5.1.5 Collaborate

Command	Description
`fetch`	Download objects and refs from another repository
`pull`	Fetch from and integrate with another repository or a local branch
`push`	Update remote refs along with associated objects

5.2 Git Flow

- *Branches*

5.2.1 Branches

- `master` - protected branch - Production releases
- `develop` - protected branch - main developement merge of all `feature` branches
- `feature/*` - for each feature a separate feature branch is created fork from `develop`
- `release` - preparing `development` branch for release on `master` branch, mainly for bugfixes
- `hotfix` - quick and dirty hotfix directly into `develop` and `master` branch

5.3 Git General

- *Links*
- *Global setup*
  - *Check setup*
  - *Save Credentials*
  - *Not verify https Certificates*
- *Git Repo Creation / Cloning*
  - *Create new repo*
  - *Status of repo*
  - *Settings of repo*
  - *Clone existing repo*
  - *Revert to last commit state*
  - *Existing folder*
  - *Switch to new Remote*
  - *Get Remote Information*
  - *Change Push Remote URL*

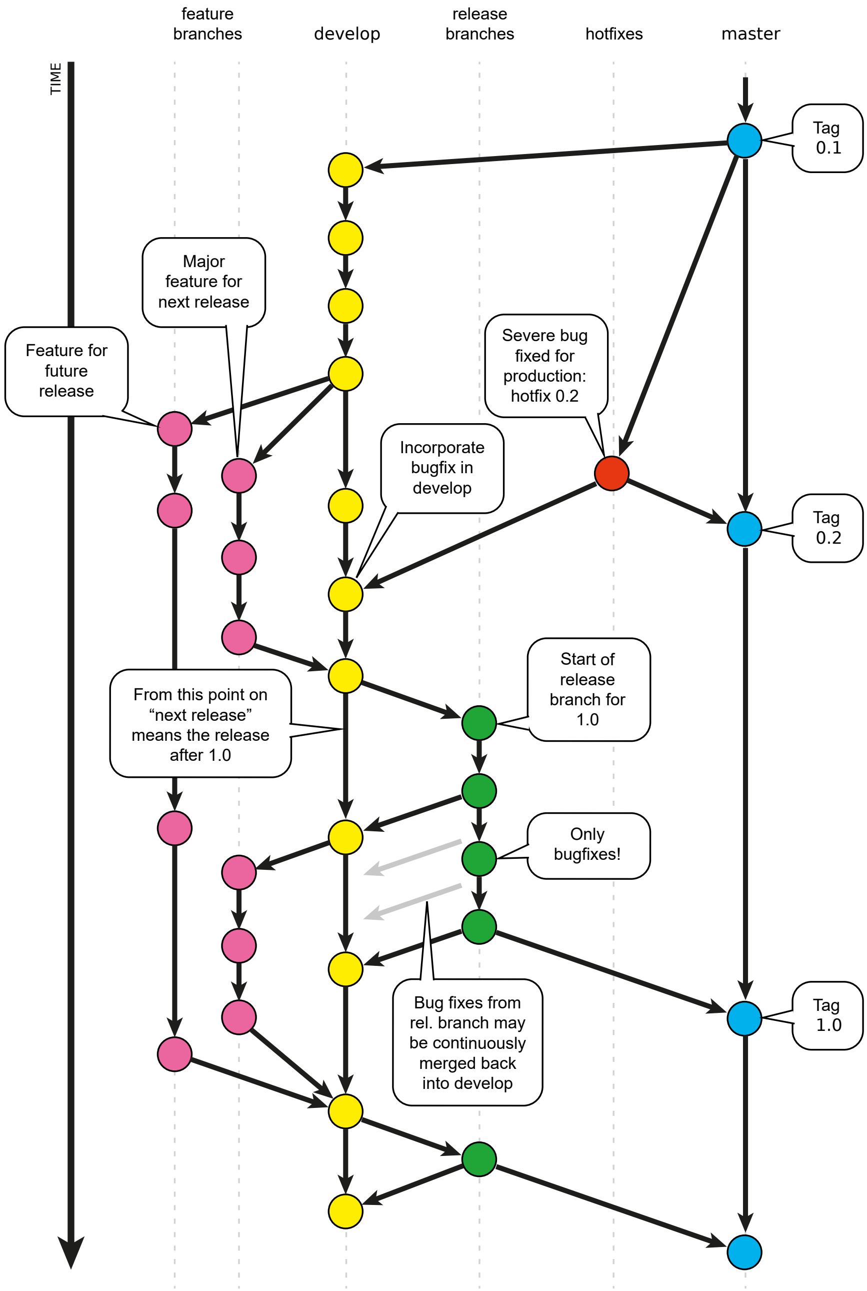

feature branches
develop
release branches
hotfixes
master
TIME
Tag 0.1
Major feature for next release
Feature for future release
Severe bug fixed for production: hotfix 0.2
Incorporate bugfix in develop
Tag 0.2
Start of release branch for 1.0
From this point on "next release" means the release after 1.0
Only bugfixes!
Bug fixes from rel. branch may be continuously merged back into develop
Tag 1.0

Figure2: Git Flow

- *Git Repo information*
- *Add Files*
- *Checkout*
- *Push*
- *Branch*
  - *Merge*

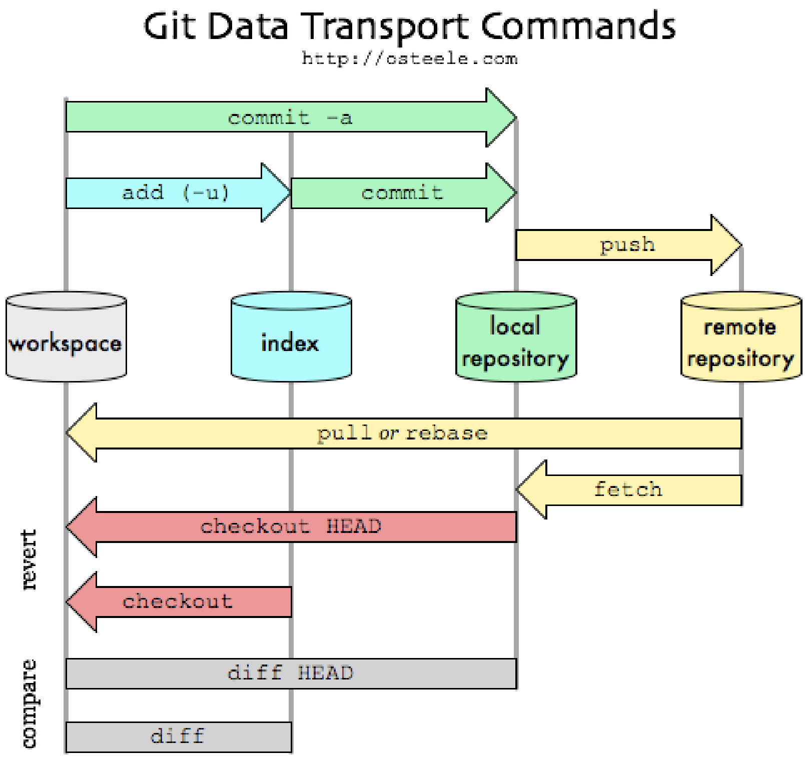


Figure3: Git Tansport

5.3.1 Links

- Bitbucket
- Github
- Gitlab
- Official Git Webpage
- Tutorial Git Branching

5.3.2 Global setup

```
git config --global user.name "username"
git config --global user.email "your@email.com"
```

Check setup

```
git config --list
```

Save Credentials

```
git config credential.helper store
```

Not verify https Certificates

```
git config --global http.sslVerify false
```

5.3.3 Git Repo Creation / Cloning

Create new repo

```
git init
```

Status of repo

```
git status
```

Settings of repo

```
git remote -v
```

Clone existing repo

```
git clone git@gitlab.hevs.ch:course/ElN/eln_labs.git
cd eln_labs
touch README.md
git add README.md
git commit -m "add README"
git push -u origin master
```

Revert to last commit state

go back to last committed servers state (can’t be undone)

```
git reset --hard
```

Existing folder

```
cd existing_folder
git init
git remote add origin git@gitlab.hevs.ch:course/ElN/eln_labs.git
git add .
git commit -m "Initial commit"
git push -u origin master
```

Switch to new Remote

```
cd existing_repo
git remote rename origin old-origin
git remote add origin git@gitlab.hevs.ch:course/ElN/eln_labs.git
git push -u origin --all
git push -u origin --tags
```

Get Remote Information

```
git remote show origin
```

Change Push Remote URL

```
git remote set-url --push <new_repo_push_url>
```

5.3.4 Git Repo information

```
# Status about current files ion folder
git status

# Status about last commits
git log --oneline
```

5.3.5 Add Files

```
# Stage a File
git add README.md

# Commit file
git commit –m "Initial commit, add README file"
```

5.3.6 Checkout

```
# Checkout certain commit
git checkout e006db0 -b inspectingPrev

# Checkout given branch
git chekout master
```

5.3.7 Push

```
git push origin master
```

5.3.8 Branch

```
# Create new branch
git branch dev_branch_1

# List all existing branches
git branch

# Checkout certain branch
git branch dev_branch_1

# Delete certain branch
git branch -d dev_branch_1
```

Merge

```
# Checkout branch you want to merge into
git checkout master
# Merge the two branches
git merge dev_branch_1
```

5.4 .gitignore

Get useful gitignore at gitignore.io

Gitignore entries

```
*.bak           # all files with a given ending
DS_Store        # specific files
._*             # all ._ files

build/          # folder
build/out       # subfolder

build/*         # all files in folder
build/out/*     # all files in subfolder

!build/file.txt # except the given file

**/Entity/*~    # some subfolder name
```

5.5 Git Submodules

- *Clone Repo with submodules*
- *Pull changes*
  - *Pull all changes in the repo including changes in the submodules*
  - *Pull all changes for the submodules*
- *Add submodule and define the master branch as the one you want to track*
- *Move Submodule*

5.5.1 Clone Repo with submodules

```
git clone --recursive [URL to Git repo]
```

5.5.2 Pull changes

Pull all changes in the repo including changes in the submodules

```
git pull --recurse-submodules
```

Pull all changes for the submodules

```
git submodule update --remote
```

5.5.3 Add submodule and define the master branch as the one you want to track

```
git submodule add -b master [URL to Git repo]

git submodule init
```

5.5.4 Move Submodule

```
git mv a b
```

Chapter 6

Jupyter

6.1 Common Functions

- *Common Jupyterlab and Nodejs functions*
  - *install nvm*
  - *Install nodejs via conda*
  - *update npm*
  - *Rebuild Jupyterlab*
  - *Remove nodejs and npm*
- *Auto import of Libraries*
- *Check*

6.1.1 Common Jupyterlab and Nodejs functions

install nvm

```
https://github.com/creationix/nvm
curl -o- https://raw.githubusercontent.com/creationix/nvm/v0.34.0/install.sh | zsh
### Install latest nodejs
nvm install node # "node" is an alias for the latest version
```

Install nodejs via conda

```
conda install -c conda-forge nodejs
```

update npm

```
sudo npm install -g npm
```

Rebuild Jupyterlab

```
jupyter lab build
```

Remove nodejs and npm

```
conda remove nodejs npm
```

6.1.2 Auto import of Libraries

- Navigate to `~/.ipython/profile_default`
- Create a folder called `startup` if it's not already there
- Add a new Python file called `start.py`
- Put your favorite imports in this file
- Launch IPython or a Jupyter Notebook and your favorite libraries will be automatically loaded every time!

Example `start.py`

```
import pandas as pd
import numpy as np

# Pandas options
pd.options.display.max_columns = 30
pd.options.display.max_rows = 20

from IPython import get_ipython
ipython = get_ipython()

# If in ipython, load autoreload extension
if 'ipython' in globals():
    print('\nWelcome to IPython!')
    ipython.magic('load_ext autoreload')
    ipython.magic('autoreload 2')

# Display all cell outputs in notebook
from IPython.core.interactiveshell import InteractiveShell
InteractiveShell.ast_node_interactivity = 'all'

# Visualization
import plotly.plotly as py
import plotly.graph_objs as go
from plotly.offline import iplot, init_notebook_mode
```

(continues on next page)

(continued from previous page)

```
init_notebook_mode(connected=True)
import cufflinks as cf
cf.go_offline(connected=True)
cf.set_config_file(theme='pearl')

print('Your favorite libraries have been loaded.')
```

6.1.3 Check

Confirm that Libraries are loaded with

```
globals()
```

6.2 Extensions

- *Installed extensions*

6.2.1 Installed extensions

```
jupyter labextension list
```

6.3 General

- *Anaconda / Conda Update*
- *nbconvert*
  - *Convert to python for linting*
  - *Convert to html*
  - *Convert to pdf*

6.3.1 Anaconda / Conda Update

```
# Update all Conda packages
conda update --all

# Update Anaconda only
conda update conda
conda update anaconda
```

6.3.2 nbconvert

Converts jupyter notebook to other formats

```
jupyter nbconvert --to <format> notebook.ipynb
```

formats are:

- `--to html` - HTML
  - `--template full` (default)
  - `--template basic`
- `--to latex` - LaTeX
  - `--template article` (default)
  - `--template report`
  - `--template basic`
- `--to pdf` - PDF
  - `--template article` (default)
  - `--template report`
  - `--template basic`
- `--to sildes` - Reveal.js HTML slideshow
- `--to markdown` - Markdown
- `--to rst` - reStructuredText
- `--to script` - executable script (.py)
- `--to notebook` -

Convert to python for linting

```
jupyter nbconvert --to script test.ipynb
```

Convert to html

```
jupyter nbconvert --to html test.ipynb
```

Convert to pdf

needs Latex installed see: *LaTeX*

```
jupyter nbconvert --to latex test.ipynb
```

6.4 Plotly Dash

- *Install Plotly Dash*
  - *Checking Versions*
  - *Getting help*
  - *Jupyter integration install*
  - *To rebuild the package and the JupyterLab app*
  - *Additional Packages*
  - *Install Dash DAQ*

6.4.1 Install Plotly Dash

```
# The core dash backend
pip install dash==0.43.0
# DAQ components (newly open-sourced!)
pip install dash-daq==0.1.0
```

Checking Versions

```
import dash_core_components
print(dash_core_components.__version__)
```

Getting help

```
help(dcc.Dropdown)
```

Jupyter integration install

```
git clone https://github.com/plotly/jupyterlab-dash
cd jupyterlab-dash
npm install
npm run build
jupyter labextension link .
~/anaconda3/bin/./python -m pip install -e .
```

To rebuild the package and the JupyterLab app

```
npm run build
jupyter lab build
```

Additional Packages

```
pip install aiohttp
pip install django_plotly_dash
pip install jupyter_plotly_dash
```

Install Dash DAQ

```
pip install dash_daq
```

6.5 Installation

- *My Extension list*
  - *All in one install*
  - *Add install R to jupyter*
  - *Add install pandoc and inkscape to conda*
- *Install Python Additional Stuff*
  - *Graphviz*
  - *Install python Libraries*
- *Problems*
  - *Anaconda Navigator not starting*
- *Install Plotly and Plotly Express*
- *Better PDF Export*

see also jupyter config

6.5.1 My Extension list

```
jupyter labextension install @jupyter-widgets/jupyterlab-manager
jupyter labextension install @jupyterlab/statusbar-extension
jupyter labextension install @jupyterlab/geojson-extension
jupyter labextension install @jupyterlab/git
pip install -e git+https://github.com/jupyterlab/jupyterlab-git.git#egg=jupyterlab_git
jupyter serverextension enable --py jupyterlab_git --sys-prefix
jupyter labextension install @jupyterlab/plotly-extension
jupyter labextension install @jupyterlab/toc
jupyter labextension install @deathbeds/jupyterlab_graphviz
```

(continues on next page)

(continued from previous page)

```
jupyter labextension install @ryantam626/jupyterlab_sublime
jupyter labextension install jupyter-matplotlib
jupyter labextension install jupyterlab_bokeh
jupyter labextension install @mflevine/jupyterlab_html
jupyter labextension install jupyterlab-drawio
jupyter labextension install jupyterlab-flake8
# jupyter labextension install jupyterlab_nbmetadata
jupyter labextension install jupyterlab_hidecode
jupyter labextension install @krassowski/jupyterlab_go_to_definition
jupyter labextension install @lckr/jupyterlab_variableinspector
```

All in one install

```
jupyter labextension install @lckr/jupyterlab_variableinspector @krassowski/jupyterlab_go_to_definition @jupyter-widgets/jupyterlab-manager @jupyterlab/statusbar-extension @jupyterlab/geojson-extension @jupyterlab/plotly-extension @jupyterlab/toc @deathbeds/jupyterlab_graphviz jupyterlab_hidecode @ryantam626/jupyterlab_sublime jupyter-matplotlib jupyterlab_bokeh @mflevine/jupyterlab_html jupyterlab-drawio jupyterlab-flake8
pip install -e git+https://github.com/jupyterlab/jupyterlab-git.git#egg=jupyterlab_git
jupyter serverextension enable --py jupyterlab_git --sys-prefix
```

Add install R to jupyter

```
conda install -c r r-essentials
```

Add install pandoc and inkscape to conda

```
conda install -c conda-forge pandoc
conda install -c conda-forge inkscape
```

6.5.2 Install Python Additional Stuff

Graphviz

Install Graphviz from https://graphviz.gitlab.io/download/ put Graphviz/bin in your PATH

```
pip install graphviz
```

Install python Libraries

```
pip install pixiedust
pip install SchemDraw
pip install nbwavedrom
pip install flake8
pip install pyflakes
pip install nbconvert
pip install watermark
```

oneline

```
pip install pixiedust SchemDraw nbwavedrom flake8 pyflakes nbconvert graphviz
```

6.5.3 Problems

Anaconda Navigator not starting

When starting anaconda-navigator produces the follwowing error.

```
$ anaconda-navigator.exe
Traceback (most recent call last):
  File "c:\Users\silvan.zahno\AppData\Local\Continuum\anaconda3\lib\site-packages\
↪qtpy\__init__.py", line 202, in <module>
    from PySide import __version__ as PYSIDE_VERSION  # analysis:ignore
ModuleNotFoundError: No module named 'PySide'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "c:\Users\silvan.zahno\AppData\Local\Continuum\anaconda3\Scripts\anaconda-
↪navigator-script.py", line 6, in <module>
    from anaconda_navigator.app.main import main
  File "c:\Users\silvan.zahno\AppData\Local\Continuum\anaconda3\lib\site-packages\
↪anaconda_navigator\app\main.py", line 22, in <module>
    from anaconda_navigator.utils.conda import is_conda_available
  File "c:\Users\silvan.zahno\AppData\Local\Continuum\anaconda3\lib\site-packages\
↪anaconda_navigator\utils\__init__.py", line 15, in <module>
    from qtpy.QtGui import QIcon
  File "c:\Users\silvan.zahno\AppData\Local\Continuum\anaconda3\lib\site-packages\
↪qtpy\__init__.py", line 208, in <module>
    raise PythonQtError('No Qt bindings could be found')
qtpy.PythonQtError: No Qt bindings could be found
```

```
pip uninstall PyQt5
conda update conda
conda update anaconda-navigator
anaconda-navigator.exe
```

6.5.4 Install Plotly and Plotly Express

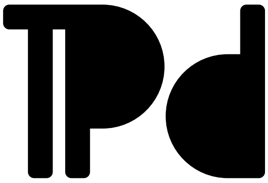
```
conda install -c plotly plotly_express plotly-orca
```

6.5.5 Better PDF Export

```
sudo apt-get install texlive-xetex
pip install jupyter_contrib_nbextensions
pip install cite2c
```

Chapter 7

Pandoc



7.1 Pandoc

- *Additional Arguments*
  - *Highlight Styles*
  - *PDF Output*
    - *For my template needed packages*
  - *Template*
    - *Windows*
    - *Linux*

If you need to convert files from one markup format into another, pandoc is your swiss-army knife.

- Pandoc Online
- Pandoc Download

7.1.1 Additional Arguments

Highlight Styles

```
# List all Highlight Styles
pandoc --list-highlight-styles
pygments
tango
espresso
zenburn
kate
monochrome
breezedark
haddock

## Pandoc Argument
--highlight-style breezedark
```

PDF Output

```
--pdf-engine=xelatex
```

For my template needed packages

- cm-super
  - Error no Scalable font
- koma-script
  - ! LaTeX Error: File `scrartcl.cls` not found.

Template

Latex Template needs to be in the following folders

Windows

```
C:\\Users\\<username>\\AppData\\Roaming\\pandoc\\templates
```

Linux

```
~/.pandoc/templates/
```

```
--template=<template>.latex
```

Chapter 8

AutoHotKey AHK

8.1 Tips & Tricks

- *Comment*
- *Performance and Compatility*
- *Warnings*
- *Enable Regex for Title mach Mode*
- *Tray Icon and ToolTip*
- *Examples*
    - *For Win10 Hibernate*
    - *For Win10 Sleep*
    - *Home and End Hotkey*
- *Check for AHK Version and output message*
- *Supend a script via Hotkey*

My ahk scripts can be found in the config repo

8.1.1 Comment

```
;------------
;-- Comment
;--
```

8.1.2 Performance and Compatility

```
; Recommended for performance and compatibility with future AutoHotkey releases
#NoEnv
```

8.1.3 Warnings

```
; Enable warnings to assist with detecting common errors
#Warn
```

8.1.4 Enable Regex for Title mach Mode

```
SetTitleMatchMode,RegEx ; then
IfWinExist, Total Commander.*
```

8.1.5 Tray Icon and ToolTip

```
Menu, TRAY, Icon, Favicon.ico
Menu, TRAY, Tip, Tooltip Text
```

8.1.6 Examples

For Win10 Hibernate

```
; Wait for Hotkey
;   Ctrl + Win + Alt + l
; Send Hotkey
;   Ctrl + Win + x + u + s
^#<!l::Send #xuh
```

For Win10 Sleep

```
; Wait for Hotkey
;   Ctrl + Win + l
; Send Hotkey
;   Win + x + u + s
^#l::Send #xus
```

Home and End Hotkey

```
; Ctrl + Left
^Left::Send {Home}
; Ctrl + Right
^Right::Send {End}
```

8.1.7 Check for AHK Version and output message

```
If (A_AhkVersion < "1.0.39.00")
{
    MsgBox,20,,This script may not work properly with your version of AutoHotkey. Continue?
    IfMsgBox,No
    ExitApp
}
```

8.1.8 Supend a script via Hotkey

```
f1::suspend
```

8.2 Key Definitions

- *Raw Keys*
- *Double Keypress Detection*

8.2.1 Raw Keys

```
^  ; Ctrl
#  ; Win
<# ; Left Win
># ; Right Win
!  ; Alt
>! ; Right Altt
<! ; Left Alt
+  ; Shift
>+ ; Right Shift
<+ ; Left Shift
^  ; Control
<^ ; Left Control
>^ ; Right Control
; Multimedia
{Volume_Up}
{Volume_Down}
{Volume_Mute}
```

8.2.2 Double Keypress Detection

Alt Key in the example

```
~Alt::
DoubleAlt := A_PriorHotkey ="~Alt" AND A_TimeSincePriorHotkey < 400
Sleep 0
KeyWait Alt  ; This prevents the keyboard's auto-repeat feature from interfering.
return
```

8.3 Tips & Tricks

- *Comment*
- *Performance and Compatility*
- *Warnings*
- *Enable Regex for Title mach Mode*
- *Tray Icon and ToolTip*
- *Examples*
  - *For Win10 Hibernate*
  - *For Win10 Sleep*
  - *Home and End Hotkey*
- *Check for AHK Version and output message*
- *Supend a script via Hotkey*

My ahk scripts cna be found in the config repo

8.3.1 Comment

```
;------------
;-- Comment
;--
```

8.3.2 Performance and Compatility

```
; Recommended for performance and compatibility with future AutoHotkey releases
#NoEnv
```

8.3.3 Warnings

```
; Enable warnings to assist with detecting common errors
#Warn
```

8.3.4 Enable Regex for Title mach Mode

```
SetTitleMatchMode,RegEx ; then
IfWinExist, Total Commander.*
```

8.3.5 Tray Icon and ToolTip

```
Menu, TRAY, Icon, Favicon.ico
Menu, TRAY, Tip, Tooltip Text
```

8.3.6 Examples

For Win10 Hibernate

```
; Wait for Hotkey
;   Ctrl + Win + Alt + l
; Send Hotkey
;   Ctrl + Win + x + u + s
^#<!l::Send #xuh
```

For Win10 Sleep

```
; Wait for Hotkey
;   Ctrl + Win + l
; Send Hotkey
;   Win + x + u + s
^#l::Send #xus
```

Home and End Hotkey

```
; Ctrl + Left
^Left::Send {Home}
; Ctrl + Right
^Right::Send {End}
```

8.3.7 Check for AHK Version and output message

```
If (A_AhkVersion < "1.0.39.00")
{
    MsgBox,20,,This script may not work properly with your version of AutoHotkey. Continue?
    IfMsgBox,No
    ExitApp
}
```

8.3.8 Supend a script via Hotkey

```
f1::suspend
```

Chapter 9

Python

9.1 Docstring

- *Python begin file*
- *Variables*
- *Functions*
  - *Function with types*
  - *Function with pep484 type annotations*
  - *Function modules level*
  - *Function - other examples*
- *Class*

9.1.1 Python begin file

```
#!/usr/bin/python3
# -*- coding: utf-8 -*-

"""Example NumPy style docstrings.

This module demonstrates documentation as specified by the `NumPy
Documentation HOWTO`_. Docstrings may extend over multiple lines. Sections
are created with a section header followed by an underline of equal length.
```

(continues on next page)

(continued from previous page)

```

Example
-------
Examples can be given using either the ``Example`` or ``Examples``
sections. Sections support any reStructuredText formatting, including
literal blocks::

    $ python example_numpy.py


Section breaks are created with two blank lines. Section breaks are also
implicitly created anytime a new section starts. Section bodies *may* be
indented:

Notes
-----
    This is an example of an indented section. It's like any other section,
    but the body is indented to help it stand out from surrounding text.

If a section is indented, then a section break is created by
resuming unindented text.

Attributes
----------
module_level_variable1 : int
    Module level variables may be documented in either the ``Attributes``
    section of the module docstring, or in an inline docstring immediately
    following the variable.

    Either form is acceptable, but the two should not be mixed. Choose
    one convention to document module level variables and be consistent
    with it.


.. _NumPy Documentation HOWTO:
   https://github.com/numpy/numpy/blob/master/doc/HOWTO_DOCUMENT.rst.txt

"""
```

9.1.2 Variables

```
module_level_variable1 = 12345

module_level_variable2 = 98765
"""int: Module level variable documented inline.

The docstring may span multiple lines. The type may optionally be specified
on the first line, separated by a colon.
"""
```

9.1.3 Functions

Function with types

```
def function_with_types_in_docstring(param1, param2):
    """Example function with types documented in the docstring.

    `PEP 484`_ type annotations are supported. If attribute, parameter, and
    return types are annotated according to `PEP 484`_, they do not need to be
    included in the docstring:

    Parameters
    ----------
    param1 : int
        The first parameter.
    param2 : str
        The second parameter.

    Returns
    -------
    bool
        True if successful, False otherwise.

    .. _PEP 484:
        https://www.python.org/dev/peps/pep-0484/

    """
```

Function with pep484 type annotations

```
def function_with_pep484_type_annotations(param1: int, param2: str) -> bool:
    """Example function with PEP 484 type annotations.

    The return type must be duplicated in the docstring to comply
    with the NumPy docstring style.

    Parameters
    ----------
    param1
        The first parameter.
    param2
        The second parameter.

    Returns
    -------
    bool
        True if successful, False otherwise.

    """
```

Function modules level

```
def module_level_function(param1, param2=None, *args, **kwargs):
    """This is an example of a module level function.

    Function parameters should be documented in the ``Parameters`` section.
    The name of each parameter is required. The type and description of each
    parameter is optional, but should be included if not obvious.

    If \*args or \*\*kwargs are accepted,
    they should be listed as ``*args`` and ``**kwargs``.

    The format for a parameter is::

        name : type
            description

            The description may span multiple lines. Following lines
            should be indented to match the first line of the description.
            The ": type" is optional.

            Multiple paragraphs are supported in parameter
            descriptions.

    Parameters
    ----------
    param1 : int
        The first parameter.
    param2 : :obj:`str`, optional
        The second parameter.
    *args
        Variable length argument list.
    **kwargs
        Arbitrary keyword arguments.

    Returns
    -------
    bool
        True if successful, False otherwise.

        The return type is not optional. The ``Returns`` section may span
        multiple lines and paragraphs. Following lines should be indented to
        match the first line of the description.

        The ``Returns`` section supports any reStructuredText formatting,
        including literal blocks::

            {
                'param1': param1,
                'param2': param2
            }

    Raises
    ------
    AttributeError
        The ``Raises`` section is a list of all exceptions
        that are relevant to the interface.
    ValueError
        If `param2` is equal to `param1`.

    """
    if param1 == param2:
```

(continues on next page)

(continued from previous page)

```
        raise ValueError('param1 may not be equal to param2')
    return True
```

Function - other examples

```
def example_generator(n):
    """Generators have a ``Yields`` section instead of a ``Returns`` section.

    Parameters
    ----------
    n : int
        The upper limit of the range to generate, from 0 to `n` - 1.

    Yields
    ------
    int
        The next number in the range of 0 to `n` - 1.

    Examples
    --------
    Examples should be written in doctest format, and should illustrate how
    to use the function.

    >>> print([i for i in example_generator(4)])
    [0, 1, 2, 3]

    """
    for i in range(n):
        yield i
```

```
class ExampleError(Exception):
    """Exceptions are documented in the same way as classes.

    The __init__ method may be documented in either the class level
    docstring, or as a docstring on the __init__ method itself.

    Either form is acceptable, but the two should not be mixed. Choose one
    convention to document the __init__ method and be consistent with it.

    Note
    ----
    Do not include the `self` parameter in the ``Parameters`` section.

    Parameters
    ----------
    msg : str
        Human readable string describing the exception.
    code : :obj:`int`, optional
        Numeric error code.

    Attributes
    ----------
    msg : str
        Human readable string describing the exception.
    code : int
        Numeric error code.

    """
```

(continues on next page)

(continued from previous page)

```
    def __init__(self, msg, code):
        self.msg = msg
        self.code = code
```

9.1.4 Class

```
class ExampleClass(object):
    """The summary line for a class docstring should fit on one line.

    If the class has public attributes, they may be documented here
    in an ``Attributes`` section and follow the same formatting as a
    function's ``Args`` section. Alternatively, attributes may be documented
    inline with the attribute's declaration (see __init__ method below).

    Properties created with the ``@property`` decorator should be documented
    in the property's getter method.

    Attributes
    ----------
    attr1 : str
        Description of `attr1`.
    attr2 : :obj:`int`, optional
        Description of `attr2`.

    """

    def __init__(self, param1, param2, param3):
        """Example of docstring on the __init__ method.

        The __init__ method may be documented in either the class level
        docstring, or as a docstring on the __init__ method itself.

        Either form is acceptable, but the two should not be mixed. Choose one
        convention to document the __init__ method and be consistent with it.

        Note
        ----
        Do not include the `self` parameter in the ``Parameters`` section.

        Parameters
        ----------
        param1 : str
            Description of `param1`.
        param2 : :obj:`list` of :obj:`str`
            Description of `param2`. Multiple
            lines are supported.
        param3 : :obj:`int`, optional
            Description of `param3`.

        """
        self.attr1 = param1
        self.attr2 = param2
        self.attr3 = param3  #: Doc comment *inline* with attribute

        #: list of str: Doc comment *before* attribute, with type specified
        self.attr4 = ["attr4"]

        self.attr5 = None
```

(continues on next page)

(continued from previous page)

```
        """str: Docstring *after* attribute, with type specified."""

    @property
    def readonly_property(self):
        """str: Properties should be documented in their getter method."""
        return "readonly_property"

    @property
    def readwrite_property(self):
        """:obj:`list` of :obj:`str`: Properties with both a getter and setter
        should only be documented in their getter method.

        If the setter method contains notable behavior, it should be
        mentioned here.
        """
        return ["readwrite_property"]

    @readwrite_property.setter
    def readwrite_property(self, value):
        value

    def example_method(self, param1, param2):
        """Class methods are similar to regular functions.

        Note
        ----
        Do not include the `self` parameter in the ``Parameters`` section.

        Parameters
        ----------
        param1
            The first parameter.
        param2
            The second parameter.

        Returns
        -------
        bool
            True if successful, False otherwise.

        """
        return True

    def __special__(self):
        """By default special members with docstrings are not included.

        Special members are any methods or attributes that start with and
        end with a double underscore. Any special member with a docstring
        will be included in the output, if
        ``napoleon_include_special_with_doc`` is set to True.

        This behavior can be enabled by changing the following setting in
        Sphinx's conf.py::

            napoleon_include_special_with_doc = True

        """
        pass

    def __special_without_docstring__(self):
        pass
```

(continues on next page)

(continued from previous page)

```
    def _private(self):
        """By default private members are not included.

        Private members are any methods or attributes that start with an
        underscore and are *not* special. By default they are not included
        in the output.

        This behavior can be changed such that private members *are* included
        by changing the following setting in Sphinx's conf.py::

            napoleon_include_private_with_doc = True

        """
        pass

    def _private_without_docstring(self):
        pass
```

9.2 General

- *flake8*
    - *.flake8*

Python samples

9.2.1 flake8

```
python -m flake8 test.py
```

.flake8

Flake8 configuration file is formated at `ini` File. and located at:

- Linux - `~/.config/flake8`
- Windows - `%userprofile%\.flake8`

see my config .flake8

```
[flake8]
max-line-length = 200

ignore =
  #E501: Line too long
  E501

  #E722 do not use bare 'except'
  E722

  #W504 line break after binary operator (one has to disable one of the W503/W504␣
↪pair)
```

(continues on next page)

(continued from previous page)

```
  W504

  #W391 blank line at end of file
  W391

exclude =
    .git,
    __pycache__,
    docs/source/conf.py,
    old,
    build,
    dist
```

9.3 Flake 8

- *.flake8*

Python samples

```
python -m flake8 test.py
```

9.3.1 .flake8

Flake8 configuration file is formated at `ini` File. and located at:

- Linux - `~/.config/flake8`
- Windows - `%userprofile%\.flake8`

see my config .flake8

```
[flake8]
max-line-length = 200

ignore =
  #E501: Line too long
  E501

  #E722 do not use bare 'except'
  E722

  #W504 line break after binary operator (one has to disable one of the W503/W504␣
↪pair)
  W504

  #W391 blank line at end of file
  W391

exclude =
    .git,
    __pycache__,
    docs/source/conf.py,
    old,
    build,
    dist
```

9.4 PIP

- *Admin*
- *Package*
- *Create requirements.txt*

9.4.1 Admin

```
# Show pip help
pip --help

# Show installed pip version
pip --version

# Update pip (Linux)
pip install --upgrade pip

# Update pip (Windows)
python -m pip install --upgrade pip
```

9.4.2 Package

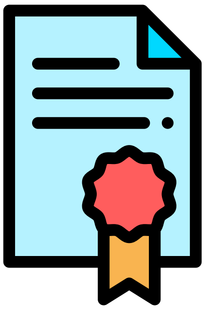
```
# Search a package
pip search <packagename>

# See package version
pip show <packagename>

# See all installed packages
pip list

# Install
pip install <packagename>
pip install -I <packagename>==<package version>
pip install -I ipython==5.4.0

# Uninstall
pip uninstall <packagename>
```

9.4.3 Create requirements.txt

```
pip freeze > requirements.txt
```

Chapter 10

Licenses



10.1 All rights reserved

```
All Rights Reserved

Copyright (c) 2019 - tschinz

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR
IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY,
FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE
AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER
LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM,
OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN
THE SOFTWARE.
```

10.2 MIT

```
MIT License

Copyright (c) 2019 tschinz

Permission is hereby granted, free of charge, to any person obtaining a copy
of this software and associated documentation files (the "Software"), to deal
in the Software without restriction, including without limitation the rights
to use, copy, modify, merge, publish, distribute, sublicense, and/or sell
copies of the Software, and to permit persons to whom the Software is
furnished to do so, subject to the following conditions:
```

(continues on next page)

(continued from previous page)

```
The above copyright notice and this permission notice shall be included in all
copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR
IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY,
FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE
AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER
LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM,
OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
SOFTWARE.
```

10.3 WTFPL

```
           DO WHAT THE FUCK YOU WANT TO PUBLIC LICENSE
                   Version 2, December 2004

Copyright (C) 2004 Sam Hocevar <sam@hocevar.net>

Everyone is permitted to copy and distribute verbatim or modified
copies of this license document, and changing it is allowed as long
as the name is changed.

           DO WHAT THE FUCK YOU WANT TO PUBLIC LICENSE
  TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION
```

Chapter 11

ROS - Robot Operating System

11.1 Introduction

- *Philosophy*

ROS aka Robotic Operating System is not a OS itself but a framework and middleware.

- Software Framework for programming robots
- Prototype from Standfort AI Research Institute and created by Willow Garage in 2007
- Since 2013 maintained by the Open Source Robotics Foundation (OSRF)
- Consists of infrastrucutre, tools, capabilities and a ecosystem

Table1: Source : ROS Tutorial #1 - https://www.youtube.com/watch?v=9U6GDonGFHw&t=1s

Advantages	Disadvantages
Provides lots of infrastructure, tools and capabilities	Approaching maturity, but still changing
Easy to try other people's work and shar your own	Security and scalability are not first-class concerns
Large community	OSes other than Ubuntu Linux are not well supported
Free, open source, BSD license	
Great for open-source and researchers	**Not great for mission-critical tasks**

Figure1: ROS Equation

Plumbing	Tools	Capabilities	Ecosystem
Process management	Simulation	Control	Package organization
Inter-process communication	Visualization	Planning	Software distribution
Device drivers	Graphical user interface	Perception	Documentation
	Data logging	Mapping	Tutorials
		Manipulation	

11.1.1 Philosophy

- **Peer to peer** - Individual programs communicate over defined API (ROS messages, services, etc.).
- **Distributed** - Programs can be run on multiple computers and communicate over the network.
- **Multi-lingual** - ROS modules can be written in any language for which a client library exists (C++, Python, MATLAB, Java, etc.).
- **Thin** - The ROS conventions encourage contributors to create standalone libraries and then wrap those libraries so they can send and receive messages to and from other ROS modules.
- **Free and open source** - The core of ROS is released under the permissive BSD license, which allows commercial and noncommercial use.

11.2 Basics

- *Coding Rules*
- *Standard Unit in ROS*
- *Master*
- *Publisher and Subscribers*
- *Catkin Overview*
  - *`src/` Folder*
  - *`build/` Folder*
  - *`devel/` Folder*

  - *install/ Folder*
- *Messages*

11.2.1 Coding Rules

The following rules apply when writing code with ROS.

Table2: ROS Robot Programming by TurtleBot3 Developers, section 7.1.3

Type	Naming Rule	Example
Package	under_scored	`first_ros_package`
Topic, Service	under_scored	`raw_image`
File	under_scored	`turtlebot3_fake.cpp`
Namespace	under_scored	`ros_awesome_package`
Variable	under_scored	`string table_name;`
Type	camelCased	`typedef int32_t PropertiesNumber;`
Class	camelCased	`class UrlTable`
Structure	camelCased	`struct UrlTableProperties`
Enumeration Type	camelCased	`enum ChoiceNumber`
Function	camelCased	`addTableEntry()`
Method	camelCased	`void setNumEntries(int32_t_num_entries)`
Constant	ALL_CAPITALS	`const uint8_t DAYS_IN_A_WEEK = T;`
Marco	ALL_CAPITALS	`#define PI_ROUNDED 3.0`

11.2.2 Standard Unit in ROS

Table3: Source : ROS Robot Programming by TurtleBot3 Developers, section 7.1.1

Quantity	Unit
Length	Meter
Mass	Kilogram
Time	Second
Current	Ampere
Angle	Radian
Frequency	Hertz
Force	Newton
Power	Watt
Voltage	Volt
Temperature	Celsius

11.2.3 Master

ROS master is a Server tracking all network addresses of all nodes. In addition to network addresses it also tracks other information like parameters. All nodes must know the network address of the master on startup ROS_MASTER_URI.

A master can be started with the roscore command or a roslaunch will also start a master if it doesn't exists already.

```
roscore
```

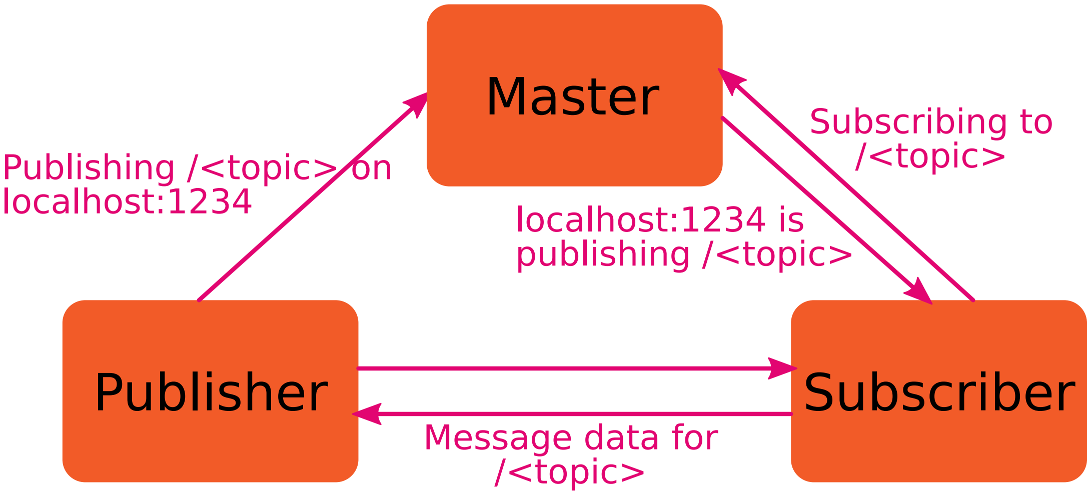

Master
Publishing /<topic> on localhost:1234
Subscribing to /<topic>
localhost:1234 is publishing /<topic>
Publisher
Subscriber
Message data for /<topic>

Figure2: ROS Master Publisher Slave

11.2.4 Publisher and Subscribers

With help of the master, publisher and subscriber establish a peer-to-peer connection. All nodes must know the network address of the master on startup ROS_MASTER_URI.

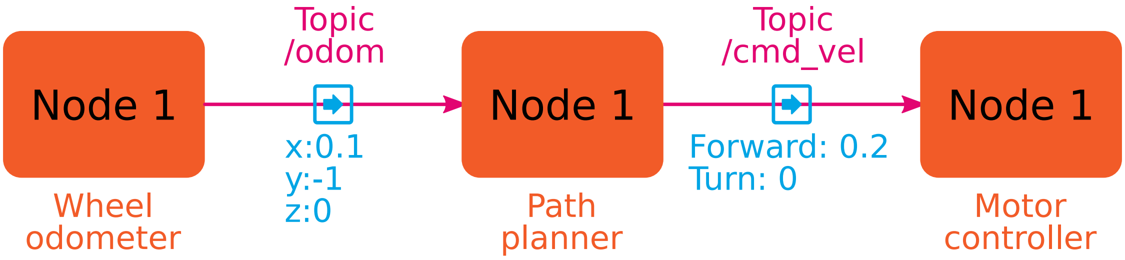


Figure3: ROS Publisher Slave

- Any node can publish a message to any topic
- Any node can subscribe to any topic

- Multiple nodes can publish to the same topic
- Multiple nodes can subscribe to the same topic
- A node can publish to multiple topics
- A node can subscribe to multiple topics

11.2.5 Catkin Overview

`src/` Folder

Location for create and clone new packages

The command `catkin_make` searches only in the `src/` folder for packages and builds them

It is a good practice to clone the ros packages into a different folder e.g. `~/git/<package_name>` and create a symlink into you catkin workspace

```
ls -s ~/git/<package_name>/ ~/catkin_ws/src/
```

`build/` Folder

`catkin_make` create buixld files and intermediate cache CMake files inside the `build/` folder.

`devel/` Folder

`catkin_make` builds each package, if successful, the target executable file is created. Executables are stored inside the `devel/` folder. Current workspace packages can be access by the command line if the following command is used:

```
# for bash
source ~/<workspace_name>/devel/setup.bash

# for zsh
source ~/<workspace_name>/devel/setup.zsh
```

It is beneficial to add this the the `~/.bashrc` or `~/.zshrc` file.

In addtion there is the `catkin_tools` program which simplifies the use.

See dedicated page: *Catkin Tools*

`install/` Folder

After building the executables in the `devel/` folder, this executables can be install by:

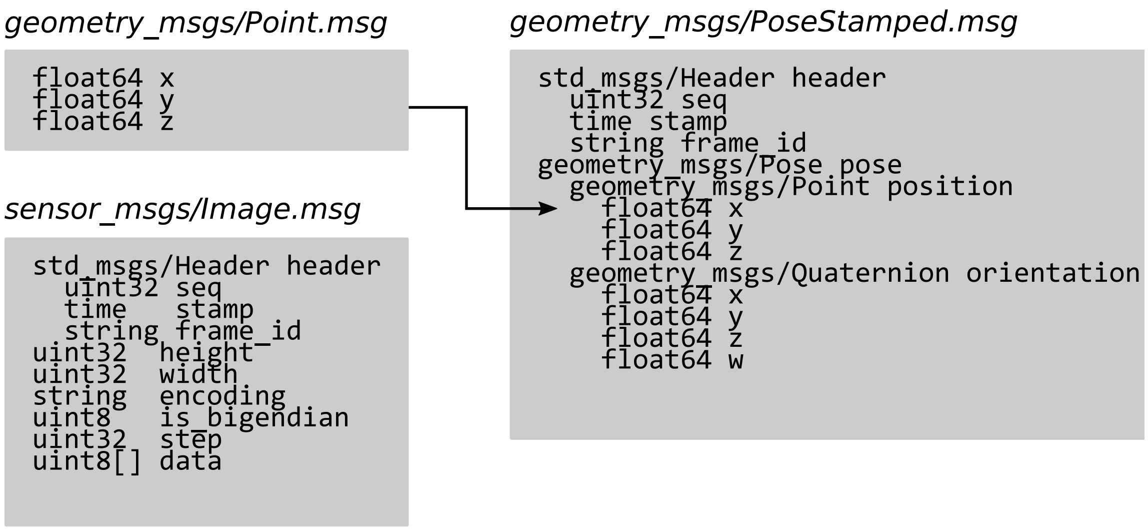
```
catkin_make install
```

See also:

- http://wiki.ros.org/catkin/workspaces#Catkin_Workspaces

11.2.6 Messages

- Serialization format for structured data
- Defined in a `.msg` file
- Compiled to C++/Python classes before using them
- more info https://wiki.ros.org/Messages



geometry_msgs/Point.msg

```
float64 x
float64 y
float64 z
```

sensor_msgs/Image.msg

```
std_msgs/Header header
  uint32 seq
  time   stamp
  string frame_id
uint32  height
uint32  width
string  encoding
uint8   is_bigendian
uint32  step
uint8[] data
```

geometry_msgs/PoseStamped.msg

```
std_msgs/Header header
  uint32 seq
  time stamp
  string frame_id
geometry_msgs/Pose pose
  geometry_msgs/Point position
    float64 x
    float64 y
    float64 z
  geometry_msgs/Quaternion orientation
    float64 x
    float64 y
    float64 z
    float64 w
```

11.3 Books summary

- *Topics*
- *SLAM (Simultaneous localization and modeling)*
- *TF (Transform Frames)*
- *QR code reader*
- *3D*
- *BAG recording*
- *Odometry and navigation*
- *Point Clouds*
- *OpenCV*

11.3.1 Topics

Basic topics such as workspace description, packages and nodes creation can be found in most of the book mentioned in this summary. They are not part of this summary since it focuses on more advanced topics. Tutorials to understand those topics are available in books or on the ROS wiki.

This summary lists all the books we have related to ROS, and some more specific PDF documents. Storage of the referenced documents :

- books : ros/books/
  - Effective_Robotics_Programming_with_ROS_3E.pdf
  - Learning_ROS_for_Robotics_Programming_2E.pdf
  - Mastering_ROS_for_Robotics_Programming.pdf
  - Programming_Robots_with_ROS.pdf
  - Programming_Robots_with_ROS-A_Practical_Introduction_to_the_Robot_Operating_System.pd
  - Robot_Operating_System_for_Absolute_Beginners.pdf
  - ROS_Robot_Programming.pdf
  - ROS_Robotics_By_Example.pdf
  - ROS_Robotics_By_Example_2E.pdf
  - Teach_ROS_with_No_Hassle_2E.pdf
- other documents : ros/slides/
  - octomap.pdf
  - ros-ethz-1.pdf
  - ros-ethz-2.pdf
  - ros-ethz-3.pdf
  - ros-ethz-4.pdf
  - ros-ethz-5a.pdf
  - ros-ethz-5b.pdf
  - ros-ethz-5c.pdf
  - ros-misc.pdf
  - ros-tf.pdf
  - ros-tf-2.pdf

11.3.2 SLAM (Simultaneous localization and modeling)

- Mastering_ROS_for_Robotics_Programming.pdf page 146

11.3.3 TF (Transform Frames)

- Effective_Robotics_Programming_with_ROS_3E.pdf page 171
- Learning_ROS_for_Robotics_Programming_2E.pdf page 305

11.3.4 QR code reader

- TODO

11.3.5 3D

- Effective_Robotics_Programming_with_ROS_3E.pdf page 120
- Learning_ROS_for_Robotics_Programming_2E.pdf page 143
- Mastering_ROS_for_Robotics_Programming.pdf page 265

11.3.6 BAG recording

- Effective_Robotics_Programming_with_ROS_3E.pdf page 128
- Learning_ROS_for_Robotics_Programming_2E.pdf page 120

11.3.7 Odometry and navigation

- Effective_Robotics_Programming_with_ROS_3E.pdf page 179
- Learning_ROS_for_Robotics_Programming_2E.pdf page 303
- Mastering_ROS_for_Robotics_Programming.pdf page 140

11.3.8 Point Clouds

- Effective_Robotics_Programming_with_ROS_3E.pdf page 394
- Learning_ROS_for_Robotics_Programming_2E.pdf page 231
- Mastering_ROS_for_Robotics_Programming.pdf page 251

11.3.9 OpenCV

- Effective_Robotics_Programming_with_ROS_3E.pdf page 359
- Mastering_ROS_for_Robotics_Programming.pdf page 250

11.4 Catkin Tools

- *Catkin build system*
    - *Installation Catkin Tools*
- *Cheat Sheet*
    - *Initialize Workspaces*
    - *Configuring Workspaces*
    - *Building Packages*
    - *Cleaning Build Products*

11.4.1 Catkin build system

This Python package provides command line tools for working with the catkin meta-buildsystem and catkin workspaces. These tools are separate from the Catkin CMake macros used in Catkin source packages. It has to be installed seperately.

- https://catkin-tools.readthedocs.io/

Installation Catkin Tools

```
# Add ROS Repositories
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu `lsb_release -sc` main" >␣
↪/etc/apt/sources.list.d/ros-latest.list'
wget http://packages.ros.org/ros.key -O - | sudo apt-key add -

# Install via apt-get
sudo apt-get update
sudo apt-get install python-catkin-tools

# Install via pip
sudo pip install -U catkin_tools
```

11.4.2 Cheat Sheet

This is a non-exhaustive list of some common and useful invocations of the `catkin` command. All of the commands which do not explicitly specify a workspace path (with `--workspace`) are assumed to be run from within a directory contained by the target workspace. For thorough documentation, please see the chapters on each verb.

Initialize Workspaces

Initialize a workspace with a default layout (`src/build/devel`) in the *current* directory:

```
catkin init
catkin init --workspace .
catkin config --init
mkdir src && catkin build
```

… with a default layout in a *different* directory:

```
catkin init --workspace /tmp/path/to/my_catkin_ws
```

… which explicitly extends another workspace:

```
catkin config --init --extend /opt/ros/indigo
```

Initialize a workspace with a **source space** called `other_src`:

```
catkin config --init --source-space other_src
```

… or a workspace with **build**, **devel**, and **install space** ending with the suffix `_alternate`:

```
catkin config --init --space-suffix _alternate
```

Configuring Workspaces

View the current configuration:

```
catkin config
```

Setting and unsetting CMake options:

```
catkin config --cmake-args -DENABLE_CORBA=ON -DCORBA_IMPLEMENTATION=OMNIORB
```

```
catkin config --no-cmake-args
```

Toggle installing to the specified **install space**:

```
catkin config --install
```

Building Packages

Build all the packages:

```
catkin build
```

… one at a time, with additional debug output:

```
catkin build -p 1
```

… and force CMake to re-configure for each one:

```
catkin build --force-cmake
```

Build a specific package and its dependencies:

```
`catkin build <package_name>
```

… or ignore its dependencies:

```
catkin build <package_name> --no-deps
```

Build the package containing the current working directory:

```
catkin build --this
```

… but don’t rebuild its dependencies:

```
catkin build --this --no-deps
```

Build packages with additional CMake args:

```
catkin build --cmake-args -DCMAKE_BUILD_TYPE=Debug
```

… and save them to be used for the next build:

```
catkin build --save-config --cmake-args -DCMAKE_BUILD_TYPE=Debug
```

Build all packages in a given directory:

```
catkin build $(catkin list -u /path/to/folder)
```

… or in the current folder:

```
catkin build $(catkin list -u .)
```

Cleaning Build Products

Blow away the build, devel, and install spaces (if they exist):

```
catkin clean
```

… or just the **build space**:

```
catkin clean --build
```

… or just clean a single package:

```
catkin clean PKGNAME
```

… or just delete the build directories for packages which have been disabled or removed:

```
catkin clean --orphans
```

11.5 Commandline Commands

- *Commandline Variables*
- *Useful commands*
  - *ROS tools*
    - *roscore*
    - *rosversion*
    - *rosparam*
    - *rosnode*
    - *rostopic*
    - *roslaunch*
    - *rosrun*
    - *rosservice*
    - *rosbag*
    - *rosmsg*
    - *Other Commands*
  - *Catkin*
    - *Create Package*
    - *Build*
    - *Install*
    - *Python modules*
- *Update services with RQT*

11.5.1 Commandline Variables

```
echo $<variable_name>         # To display value

ROS_DISTRO                    # Distro name e.g. melodic
ROS_ETC_DIR                   #
ROS_LISP_PACKAGE_DIRECTORIES # common-lisp folder e.g. ~/catkin_ws/devel/share/
↪common-lisp
ROS_HOSTNAME                  # ros hostname e.g. localhost
ROS_MASTER_URI                # ros master url e.g. http://localhost:11311
ROS_PACKAGE_PATH              # package path's e.g. ~/catkin_ws/src:/opt/ros/$(ROS_
↪DISTRO)/share
ROS_PYTHON_VERSION            # python version 2 or 3 e.g. 2
ROS_ROOT                      # ros installation e.g. /opt/ros/$(ROS_DISTRO)/share/
↪ros
ROS_VERSION                   # ros version 1 or 2 e.g. 1
```

11.5.2 Useful commands

ROS tools

roscore

Launch ROS master core

```
roscore
```

rosversion

```
rosversion -d                             # Print ROS distro name
rosversion <package_name>                 # Print package vrosnode
```

rosparam

Nodes use the parameter server to store and retrieve parameters at runtime.

http://wiki.ros.org/rosparam

```
rosparam list                             # list parameter names
rosparam set /<parameter_name> <value>    # set parameter
rosparam get /<parameter_name>            # get parameter
rosparam delete /<parameter_name>         # delete parameter
rosparam dump <file>                      # dump parameter to file
rosparam load                             # load parameter from file
```

rosnode

Work with nodes

```
rosnode list                              # list all nodes
rosnode ping /<node_name>                 # check node connectivity
rosnode info /<node_node>                 # print information about node
rosnode machine                           # list nodes running on a particular␣
↪machine
rosnode kill /<node_name>                 # kill a running node
```

rostopic

Work with topics

```
rostopic list                             # list all topics
rostopic info /<topic_name>               # print information about active topic
rostopic echo /<topic_name>               # print messages to screen
rostopic pub /<topic_name> msg/MessageType "data:value" # pubish data to topic

rostopic type /<topic_name>               # print topic or field type
rostopic find <type>                      # find topics by type
rostopic bw /<topic_name>                 # display bandwidth used by topic
rostopic hz /<topic_name>                 # display publishing rate of topic
```

roslaunch

To start a launch file which can contain multiple nodes.

```
roslaunch <ros_pkg_name> <launch_file_name> # Launch ros launch file
```

rosrun

To run a node

```
rosrun <ros_pkg_name> <node_name>          # Start a ros node
rosrun <PACKAGE_NAME><NODE_NAME> __name:=<INSTANCE_NAME> # Start another instance␣
↪of a node, the parameter *INSTANCE_NAME* can be whatever you want, but it must␣
↪be unique.
```

rosservice

Work with services

```
rosservice list                            # list active services
rosservice info <service_name>             # print information about service
rosservice uri <service_name>              # print service ROSRPC
```

rosbag

ROS offers the possibility to record the data published on topics into bag files :

1. create a directory to store the bag files:

   ```
   ~/ mkdir ros_bag_files && cd ros_bag_files
   ```

2. run the *record* command :

   ```
   rosbag record -O <bag_name>.bag <topic_name> <topic_name>
   ```

3. play the bag file :

   ```
   rosbag play <bag_name>.bag
   ```

Many options are available for the *rosbag* command, see this page for more details.

Note : to play a bag with point clouds, it is required to have the following topics :

- `/cloud`
- `/tf_static`

The TF transformation is required, otherwise RViz can't display the point clouds.

```
rosbag record -O cloud.bag /cloud /tf_static
...
rosbag play cloud.bag
```

rosmsg

Display information about ros messages.

```
rosmsg list                    # List all messages
rosmsg info <message_name>     # Show message description
rosmsg package <package_name>  # List messages in a package
rosmsg packages <package_name>  # List packages that contain messages
```

Other Commands

```
roscd <PKG_NAME>                # move to the folder of the package

rosinstall <PKG_NAME>           # install a ROS package

rosdep <PKG_NAME                # install all the dependencies of a package

rqt                             # tool with many plug-ins available such as topic␣
↪publisher, service caller, …

rqt_graph                       # display the connections between nodes

rviz                            # launch the graphical tool to visualize robots,␣
↪point clouds, …

view_frames                     # create a PDFcalled ``frames.pdf`` with the TF␣
↪frames that are active
evince frames.pdf               # show with evince the generated frames.pdf
```

Catkin

More info:

- http://wiki.ros.org/catkin/Tutorials

Create Package

1. new terminal
2. navigate to the source folder of the catkin workspace : `.../catkin_ws/src`
3. run : `catkin_create_pkg <PACKAGE_NAME> <DEPENDENCIES>`
4. update both CMakeLists.txt and package.xml note : *run_depend* has to be replaced by the *exec_depend*
5. write source code in the source folder of the package :
6. build the catkin workspace with the alias command : `cm`
7. launch the master as explained [here](ros-commands.md#roscore).
8. now launch the node as explained [here](#roslaunch) and [here](rosrun).

```
catkin_create_pkg <PKG_NAME> <PKG_DEPENDENCIES> # create a package, must be called␣
↪inside a catkin workspace
```

Build

```
cm
catkin_make                                      # build the whole workspace
catkin_make <PKG_NAME>                           # build a single package
```

Install

```
catkin_make install                              # installs all executables
catkin_make install <PKG_NAME>                   # installs single executables
```

Python modules

Tips :

- put the script in a folder called *scripts*
- make sure to run `chmod +x <script_name>.py` so that the script is recognized as an executable by ROS

11.5.3 Update services with RQT

1. launch *RQT* from a new terminal : run `rqt`
2. Search for the plugin *Service Caller*
3. Choose the service that you want to update
4. Fill the *expression* field with an expected parameter of this service
5. Call the service and the response is displayed

11.6 Installation

- *How to install ROS*
  - *Prerequisites*
    - ∗ *NTP*
    - ∗ *Sources*
    - ∗ *Keys*
  - *ROS Base*
  - *ROS Additional Packages*
    - ∗ *RQT*
    - ∗ *Individual ROS packages*
  - *Setup ROS Environment*
    - ∗ *Initialise rosdep*
    - ∗ *Environment setup*

        - *ROS Install*
        - *Create catkin workspace*
    - *Shell Scripts*
    - *Additional Install*
        - *Hitachi SDK*
- *Configuration*
    - *ROS Configuration*
        - .bashrc
        - *.zshrc*
    - *ROS Test*

11.6.1 How to install ROS

This installation is based on Ubuntu 18.4 LTS and ROS Melodic Morenia.

Prerequisites

Some tools are not mandatory.

NTP

Only needed in a multi-pc system.

```
echo "Install Chrony and ntpdate"
sudo apt-get install -y chrony ntpdate
sudo ntpdate -q ntp.ubuntu.com
```

Sources

ROS Ubunbtu apt-get packages sources.

```
echo "Add ROS Package Sources"
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" > /etc/apt/sources.list.d/ros-latest.list'
```

Ubuntu 18.04 LTS (Bionic Beaver)

```
echo "Add ROS Package Sources for Ubuntu 18.04 LTS Bionic Beaver"
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" > /etc/apt/sources.list.d/ros-latest.list'
```

Keys

- ROS Kinetic
- ROS Melodic

```
echo "Add ROS Package Key"
sudo apt-key adv --keyserver 'hkp://keyserver.ubuntu.com:80' --recv-key␣
↪C1CF6E31E6BADE8868B172B4F42ED6FBAB17C654
```

ROS Base

```
echo "Install ROS Base Desktop Full"
sudo apt-get install ros-melodic-desktop-full
```

ROS Additional Packages

RQT

```
echo "Install ROS R-QT"
sudo apt-get install ros-melodic-rqt*
```

Individual ROS packages

Search & install individual ROS packages

```
echo "Install ROS R-QT"
apt-cache search ros-melodic
sudo apt-get install ros-melodic-[NAME_OF_PACKAGE]
```

Setup ROS Environment

Initialise rosdep

```
echo "[Initialize rosdep]"
sudo sh -c "rosdep init"
rosdep update
```

Environment setup

Differs depending if it’s zsh or bash

```
echo "[Environment setup and getting rosinstall]"
if [ -n "$ZSH_VERSION" ]; then
   # assume Zsh
  source /opt/ros/$name_ros_version/setup.zsh
elif [ -n "$BASH_VERSION" ]; then
  # assume Bash
  source /opt/ros/$name_ros_version/setup.sh
fi
```

ROS Install

```
sudo apt install -y python-rosinstall python-rosinstall-generator python-wstool
```

Create catkin workspace

```
echo "[Make the catkin workspace and test the catkin_make]"
mkdir -p $HOME/$name_catkin_workspace/src
cd $HOME/$name_catkin_workspace/src
catkin_init_workspace
cd $HOME/$name_catkin_workspace
catkin_make
```

Shell Scripts

All the above can be done with help of the `ros-melodic-install.bash`

Additional Install

Hitachi SDK

```
cd ~/Downloads
echo "$INDENT Manually download http://hlds.co.jp/download/tofsdk/v2.3.0/
↪HldsTofSdk.2.3.0ubuntu16_x64.zip into your Downloads/ folder"
echo ""
echo "PRESS [ENTER] WHEN YOU'RE FINISHED AND TO CONTINUE THE INSTALLATION"
read
mkdir HldsTofSdk.2.3.0ubuntu16_x64
unzip HldsTofSdk.2.3.0ubuntu16_x64.zip -d ./HldsTofSdk.2.3.0ubuntu16_x64
sudo apt install HldsTofSdk.2.3.0ubuntu16_x64/libtof-dev_2.3.0-4ubuntu16_amd64.deb
```

11.6.2 Configuration

ROS Configuration

.bashrc

```
echo "[Set the ROS evironment in ~/.bashrc]"
echo "alias eb='vim ~/.bashrc'" >> ~/.bashrc
echo "alias sb='source ~/.bashrc'" >> ~/.bashrc
echo "alias gs='git status'" >> ~/.bashrc
echo "alias gp='git pull'" >> ~/.bashrc
echo "alias cw='cd ~/$name_catkin_workspace'" >> ~/.bashrc
echo "alias cs='cd ~/$name_catkin_workspace/src'" >> ~/.bashrc
echo "alias cm='cd ~/$name_catkin_workspace && catkin_make'" >> ~/.bashrc

echo "source /opt/ros/$name_ros_version/setup.bash" >> ~/.bashrc
echo "source ~/$name_catkin_workspace/devel/setup.bash" >> ~/.bashrc

echo "export ROS_MASTER_URI=http://localhost:11311" >> ~/.bashrc
echo "export ROS_HOSTNAME=localhost" >> ~/.bashrc
```

.zshrc

```
echo "[Set the ROS evironment in ~/.zshrc]"
echo "alias eb='vim ~/.zshrc'" >> ~/.zshrc
echo "alias sb='source ~/.zshrc'" >> ~/.zshrc
echo "alias gs='git status'" >> ~/.zshrc
echo "alias gp='git pull'" >> ~/.zshrc
echo "alias cw='cd ~/$name_catkin_workspace'" >> ~/.zshrc
echo "alias cs='cd ~/$name_catkin_workspace/src'" >> ~/.zshrc
echo "alias cm='cd ~/$name_catkin_workspace && catkin_make'" >> ~/.zshrc

echo "source /opt/ros/$name_ros_version/setup.zsh" >> ~/.zshrc
echo "source ~/$name_catkin_workspace/devel/setup.zsh" >> ~/.zshrc

echo "export ROS_MASTER_URI=http://localhost:11311" >> ~/.zshrc
echo "export ROS_HOSTNAME=localhost" >> ~/.zshrc
```

ROS Test

```
roscore
```

11.7 Launch

- *Launcher*
  - *Launch file*
    - *Arguments*
    - *Including other launch files*
  - *Create a launcher in a new package*
  - *Include another launcher inside this launcher*
  - *Parameters in launcher*
    - *Get the value of a parameter at run time*
    - *Public vs Private parameters*
- *Rviz configuration*

11.7.1 Launcher

- launch os a tool for launchine multiple nodes (as well as setting parameters)
- Are written in XM as `*.launch` files
- If not yet running, launch atuomatically stars a roscore

Browse to the folder and start a launch file with

```
roslaunch <file_name>.launch
```

Start a launch file from a package with

```
roslaunch <package_name> <file_name>.launch
```

Launch file

Listing 1: talker_listerner.launch

```
<launch>
<node name="listener" pkg="roscpp_tutorials" type="listener" output="screen"/>
<node name="talker" pkg="roscpp_tutorials" type="talker" output="screen"/>
</launch>
```

launch: Root element of the launch file

- **node**: Each `<node>` tag specifies a node to be launched
- **name**: Name of the node (free to choose)
- **pkg**: Package containing the node
- **type**: Type of the node, there must be a corresponding executable with the same name
- **output**: Specifies where to output log messages (screen: console, log: log file)

More Info

- http://wiki.ros.org/roslaunch/XML
- http://wiki.ros.org/roslaunch/Tutorials/Roslaunch%20tips%20for%20larger%20projects

Arguments

- Create re-usable launch files with `<arg>` tag, which works like a parameter (default optional)

  ```
  <arg name="arg_name" default="default_value"/>
  ```

- Use arguments in launch file with

  ```
  $(arg arg_name)
  ```

- When launching, arguments can be set with

  ```
  roslaunch launchf_file.launch arg_name:value
  ```

Example:

Listing 2: range_world.launch

```
<?xml version="1.0"?>
  <launch>
    <arg name="use_sim_time" default="true"/>
    <arg name="world" default="gazebo_ros_range"/>
    <arg name="debug" default="false"/>
    <arg name="physics" default="ode"/>

    <group if="$(arg use_sim_time)">
      <param name="/use_sim_time" value="true" />
    </group>
```

(continues on next page)

(continued from previous page)

```
    <include file="$(find gazebo_ros) /launch/empty_world.launch">
    <arg name="world_name" value="$(find gazebo_plugins)/ test/test_worlds/$(arg␣
↪world).world"/>
    <arg name="debug" value="$(arg debug)"/>
    <arg name="physics" value="$(arg physics)"/>
  </include>
</launch>
```

More info http://wiki.ros.org/roslaunch/XML/arg

Including other launch files

- Include other launch files with `<include>` tag to organize large projects

```
<include file="package_name" />
```

- Find the system path to other packages with

```
$(find package_name)
```

- Pass arguments to the included file

```
<arg name="arg_name" value="value"/>
```

Listing 3: range_world.launch

```
<?xml version="1.0"?>
<launch>
  <arg name="use_sim_time" default="true"/>
  <arg name="world" default="gazebo_ros_range"/>
  <arg name="debug" default="false"/>
  <arg name="physics" default="ode"/>

    <group if="$(arg use_sim_time)">
    <param name="/use_sim_time" value="true" />
  </group>

    <include file="$(find gazebo_ros) /launch/empty_world.launch">
    <arg name="world_name" value="$(find gazebo_plugins)/test/test_worlds/
↪$(arg world).world"/>
    <arg name="debug" value="$(arg debug)"/>
    <arg name="physics" value="$(arg physics)"/>
  </include>
</launch>
```

More info: http://wiki.ros.org/roslaunch/XML/include

Create a launcher in a new package

1. move to the folder of the package
2. run : `mkdir launch && cd launch`
3. run : `gedit <LAUNCHER_NAME>.launch`
4. fill the launcher file, for example:

```
<launch>
  <node pkg="<PACKAGE1_NAME>" type="<NODE1_NAME>" name="<INSTANCE0>"/>
  <node pkg="<PACKAGE2_NAME>" type="<NODE2_NAME>" name="<INSTANCE1>"/>
  <node pkg="<PACKAGE2_NAME>" type="<NODE2_NAME>" name="<INSTANCE2>"/>
  <node pkg="<PACKAGE2_NAME>" type="<NODE2_NAME>" name="<INSTANCE3>"/>
</launch>
```

Include another launcher inside this launcher

Add the include directive :

```
<launch>
  <include file="$(find <PKG_NAME>)/launch/<LAUNCHER_NAME>.launch" />
  </launch>
```

This is very useful to combine launcher together, or complete a first launcher :

- the first launcher is responsible to launch a driver
- the second launcher that includes the first one launches also a graphical tool on top of that

The advantage being that it is not necessary to copy paste all the code of the first launcher into the second one to use them together.

Parameters in launcher

Parameters can be set in the launcher and get by the node at run time. This is a convenient way to avoid rebuilding the code each time it is necessary to change the value of a variable, for example a path to a file.

The syntax is the following one :

```
<param name="<PARAM_NAME>" type="<TYPE>" value="<VALUE>" />
```

Get the value of a parameter at run time

It can be used in the node at run time with this C++ code :

```
ros::NodeHandle nh;
std::string iniPath;
nh.getParam("ini_path", iniPath);
```

The node handler gets the parameter called *ini_path* in the launcher and will store it in the variable *iniPath*. If the parameter is public, therefore accessible by all the nodes, this is sufficient to get its value. If the parameter is private to a node, then the node handler needs to know the name of the node :

```
ros::NodeHandle nh;
std::string iniName;
nh.getParam("tof_driver_1/ini_name", iniName);
```

To get the name of the node at run time, it is possible to use this line :

```
std::string nodeName = ros::this_node::getName();
```

Public vs Private parameters

Depending of where the parameter is declared in the launcher, the parameter will be either private to a node, or accessible by all the nodes. If the parameter is declared outside of a `<node></node>` tag, it is public and accessible to all the nodes. At the opposite, if the parameter is declared inside a `<node></node>` tag, it will only be accessible by the node, with the specific method described above.

In this example :

- The parameter *ini_path* is public and accessible by all the nodes only with its name.
- The parameter *ini_name* is private to each node and is accessible with the name of the node and its name, concatenated together. This allows to declare two time the same parameter with different value, as long as they are declared inside different nodes.

```
<launch>
      <!-- Public parameters for both nodes -->
      <param name="ini_path" type="str"
             value="$(find ros_driver_for_multiple_tof_sensors)/launch/" />

      <!-- Call the driver node for sensor 1 (IP = 192.168.0.105)-->
      <node pkg="ros_driver_for_multiple_tof_sensors"
            type="ros_driver_multiple_sensors_node" name="tof_driver_1"
            args="" required="true" output="screen" >

            <!-- Private parameter for node 1 -->
            <param name="ini_name" type="str" value="tof_sensor1.ini" />
      </node>

      <!-- Call the driver node for sensor 2 (IP = 192.168.1.105)-->
      <node pkg="ros_driver_for_multiple_tof_sensors"
            type="ros_driver_multiple_sensors_node" name="tof_driver_2"
            args="" required="true" output="screen" >

            <!-- Private parameter for node 2 -->
            <param name="ini_name" type="str" value="tof_sensor2.ini" />
      </node>
</launch>
```

11.7.2 Rviz configuration

After setting up the display configuration in Rviz, you can save it with the tab `File -> Save config as -> ...`

Then you can call it directly in the launch file by adding :

```
<node pkg="rviz" type="rviz" name="rviz"
    args="-d <PATH_TO_FILE>/<CONFIG_NAME>.rviz"/>
```

This will open Rviz with the saved configuration when the *launch* file is launched.

11.8 Lidar Driver

- *Install the SDK*

11.8.1 Install the SDK

run in a new terminal:

```
sudo dpkg -i libtof-dev_<version_number>ubuntu16_amd64.deb
```

11.9 Packages

- *Package Structure*
- *Package Files*
  - *file `package.xml`*
  - *file `CMakeLists.txt`*
- *Eclipse integration*
- *C++ Client Library*
  - *Example*
  - *Node Handle*
  - *Logging `ROS_INFO`*
    - *Severity Levels*
  - *Subscriber*
  - *Publisher*
  - *OOP*
  - *Parameter Server*
    - *C++ API*

11.9.1 Package Structure

ROS software is organized into packages, which can contain source code, launch files, configuration files, message definitions, data, and documentation. A package can depend on other packages called *dependencies*.

```
catkin_create_pkg <package_name> {dependencies}
```

A package need two things, its source code and the message definition. It is encouraging to place message definition into a separate folder.

- 📁 `package_name`
  - 📁 `config` - parameter files (YAML)
  - 📁 `include/package_name` - C++ include headers
  - 📁 `launch` - `*.launch` files
  - 📁 `src` - Source files
  - 📁 `test` - Unit and or ROS Tests
  - 📄 `CMakeList.txt` - CMake build file
  - 📄 `package.xml` - Package information
- 📁 `package_name_msgs`
  - 📁 `action` - Action definitions
  - 📁 `msg` - Message definitions
  - 📁 `src` - Service definitions
  - 📄 `CMakeList.txt` - CMake build file
  - 📄 `package.xml` - Package information

More info

- http://wiki.ros.org/Packages

11.9.2 Package Files

📄 `package.xml`

- The `package.xml` file defines the properties of the package
  - Package name
  - Version number
  - Authors

  - Dependencies on other packages
  - ...

Listing 4: package.xml

```
<?xml version="1.0"?>
<package format="2">
    <name>ros_package_template</name>
    <version>0.1.0</version>
    <description>A template for ROS packages.</description>
    <maintainer email="user@email.ch">Firstname Lastname</maintainer>
    <license>BSD</license>
    <url type="website">https://github.com/link/ros_</url>
    <author email="user@email.ch">Firstname Lastname</author>

    <buildtool_depend>catkin</buildtool_depend>

    <depend>roscpp</depend>
    <depend>sensor_msgs</depend>
</package>
```

More info

- http://wiki.ros.org/catkin/package.xml

CMakeLists.txt

The CMakeLists.txt is the input to the CMake build system

1. Required CMake Version (cmake_minimum_required)
2. Package Name (project())
3. Find other CMake/Catkin packages needed for build (find_package())
4. Message/Service/Action Generators (add_message_files(), add_service_files(), add_action_files())
5. Invoke message/service/action generation (generate_messages())
6. Specify package build info export (catkin_package())
7. Libraries/Executables to build (add_library()/add_executable()/target_link_libraries())
8. Tests to build (catkin_add_gtest())
9. Install rules (install())

Listing 5: CMakeLists.txt

```
cmake_minimum_required(VERSION 2.8.3)
project(husky_highlevel_controller)
add_definitions(--std=c++11)

find_package(catkin REQUIRED COMPONENTS roscpp sensor_msgs )

catkin_package(
  INCLUDE_DIRS include
  # LIBRARIES
  CATKIN_DEPENDS roscpp  sensor_msgs
  # DEPENDS
)
```

(continues on next page)

(continued from previous page)

```
include_directories(include ${catkin_INCLUDE_DIRS})

add_executable(${PROJECT_NAME} src/${PROJECT_NAME}_node.cpp src/
↪HuskyHighlevelController.cpp)

target_link_libraries(${PROJECT_NAME} ${catkin_LIBRARIES})
```

More info

- http://wiki.ros.org/catkin/CMakeLists.txt

11.9.3 Eclipse integration

- Build the Eclipse project files with additional build flags

  ```
  catkin build package_name --cmake-args -G"Eclipse CDT4 - Unix Makefiles” -D__
  ↪cplusplus=201103L D__GXX_EXPERIMENTAL_CXX0X__=1
  ```

- To use flags by default in your catkin environment, use the *catkin config* command.
- The Eclipse project files will be generated in *~/catkin_ws/build*

11.9.4 C++ Client Library

- http://wiki.ros.org/roscpp
- http://wiki.ros.org/roscpp/Overview

Example

```
#include <ros/ros.h>

int main(int argc, char** argv)                   // ROS main head file
{
    ros::init(argc, argv, "hello_world");         // has to be called before ROS␣
↪func's
    ros::NodeHandle nodeHandle;                   // access poiunt for␣
↪communication
    ros::Rate loopRate(10);                       // ros:Rate runs loops at␣
↪desired freq e.g. 10 = 10 Hz

    unsigned int count = 0;
    while (ros::ok()) {                           // checks if a node should␣
↪continue running
        ROS_INFO_STREAM("Hello World " << count); // ROS_info() logs messages from␣
↪fs
        ros::spinOnce();                          // processes incommind msg via␣
↪callbacks
        loopRate.sleep();
        count++;
    }
    return 0;
}
```

Node Handle

http://wiki.ros.org/roscpp/Overview/NodeHandles

```
// Default (public) node handle:      // Recommended
nh_ = ros::NodeHandle();              // /namespace/topic

// Private node handle:               // Recommended
nh_private_ = ros::NodeHandle("~");   // /namespace/node/topic

// Namespaced node handle:
nh_eth_ = ros::NodeHandle("hevs");    // /namespace/hevs/topic

// Global node handle:                // NOT Recommended
nh_global_ = ros::NodeHandle("/");    // /topic
```

Logging `ROS_INFO`

- http://wiki.ros.org/rosconsole
- http://wiki.ros.org/roscpp/Overview/Logging

Send text to log files and console. Instead of `std::cout`, use e.g. `ROS_INFO`.

Severity Levels

	Debug	Info	Warn	Error	Fatal
stdout	✓	✓			
stderr			✓	✓	✓
Log file	✓	✓	✓	✓	✓
/rosout	✓	✓	✓	✓	✓

Formatting Style

```
ROS_INFO("Result: %d", result);           // printf style
ROS_INFO_STREAM("Result: " << result);    // stream style
```

Launchfile

To see the output in the console set configuration to *screen* in the launch file.

```
<launch>
    <node name="listener" more="stuff" output="screen"/>
</launch>
```

Subscriber

http://wiki.ros.org/roscpp/Overview/Publishers%20and%20Subscribers

Start listening to a topic by calling the method subscribe() of the node handle

```
ros::Subscriber subscriber = nodeHandle.subscribe(topic, queue_size, callback_
↪function);
```

Example

Listing 6: listener.cpp

```
#include "ros/ros.h"
#include "std_msgs/String.h"

// callback function when a message is received
void chatterCallback(const std_msgs::String& msg) {
     ROS_INFO("I heard: [%s]", msg.data.c_str());
}

int main(int argc, char **argv) {
     ros::init(argc, argv, "listener");
    ros::NodeHandle nodeHandle;
    // Subscript to topic with a queue size of 10 (1-10 is recommended)
    ros::Subscriber subscriber = nodeHandle.subscribe("chatter",10,
↪chatterCallback);
    ros::spin(); // stay's here forever
    return 0;
}
```

Publisher

http://wiki.ros.org/roscpp/Overview/Publishers%20and%20Subscribers

Create a publisher with help of the node handle

```
ros::Publisher publisher = nodeHandle.advertise<message_type>(topic, queue_size);
```

Example

```
:caption: talker.cpp
#include <ros/ros.h>
#include <std_msgs/String.h>

int main(int argc, char **argv) {
    ros::init(argc, argv, "talker");
    ros::NodeHandle nh;
    // Node handle queue size of 1
    ros::Publisher chatterPublisher = nh.advertise<std_msgs::String>("chatter", 1);
    ros::Rate loopRate(10);

    unsigned int count = 0;
    while (ros::ok()) {
        std_msgs::String message;
        // Cretae message content
        message.data = "hello world " + std::to_string(count);
        ROS_INFO_STREAM(message.data);
        chatterPublisher.publish(message);
        ros::spinOnce();
        loopRate.sleep();
```

(continues on next page)

(continued from previous page)

```
        count++;
    }
    return 0;
}
```

OOP

http://wiki.ros.org/roscpp_tutorials/Tutorials/UsingClassMethodsAsCallbacks

Example

```
:caption: my_package_node.cpp
#include <ros/ros.h>
#include "my_package/MyPackage.hpp"
int main(int argc, char** argv) {
    ros::init(argc, argv, "my_package");
    ros::NodeHandle nodeHandle("~");
    // Call
    my_package::MyPackage myPackage(nodeHandle);

    ros::spin();
    return 0;
}
```

class MyPackage	class Algorithm
Main node class providing ROS interface (subscribers, parameters, timers etc.)	Class implementing the algorithmic part of the node **Note: The algorithmic part of the code could be separated in a (ROS-independent) library**

Parameter Server

http://wiki.ros.org/roscpp/Overview/Parameter%20Server

Example Parameter File

```
:caption: config.yaml

camera:
     left:
             name: left_camera
             exposure: 1
     right:
             name: right_camera
             exposure: 1.1
```

Example Launch file

```
<launch>
    <node name="name" pkg="package" type="node_type">
        <rosparam command="load" file="$(find package)/config/config.yaml" />
    </node>
</launch>
```

C++ API

```
ros::NodeHandle nodeHandle("~");
std::string topic;
if (!nodeHandle.getParam("topic", topic)) {
    ROS_ERROR("Could not find topic parameter!");
}
```

Get a parameter in C++ with

```
nodeHandle.getParam(parameter_name, variable)
```

- Method returns `true` if parameter was found, `false` otherwise
- Global and relative parameter access:
  - Global parameter name with preceding /

    ```
    nodeHandle.getParam("/package/camera/left/exposure", variable)
    ```

    Relative parameter name (relative to the node handle)

    ```
    nodeHandle.getParam("camera/left/exposure", variable)
    ```

- For parameters, typically use the private node handle

  ```
  ros::NodeHandle("~")
  ```

11.10 External Packages and Nodes

- *Terminology*
- *Overview*
- *3D Mapping*
  - *SLAM*
    - *Octomap_server : +*
    - *Hector slam : +*
    - *REMODE : ~*
  - *LOAM*
    - *RTABMAP : +*
    - *Spin Hokuyo : +*
    - *Lego-LOAM : ~*
  - *Velodyne loam : ~*
  - *Bad solution -*
- *Modbus*
- *Object Tracking*
  - *Multiple objects lidar tracking : ~*
- *Object Detection*

- *QR code readers*

11.10.1 Terminology

- + : interesting topics and hardware abstraction
- ~ : interesting, but quite a lot of work to do for hardware compatibility or mapping
- - : bad solution

11.10.2 Overview

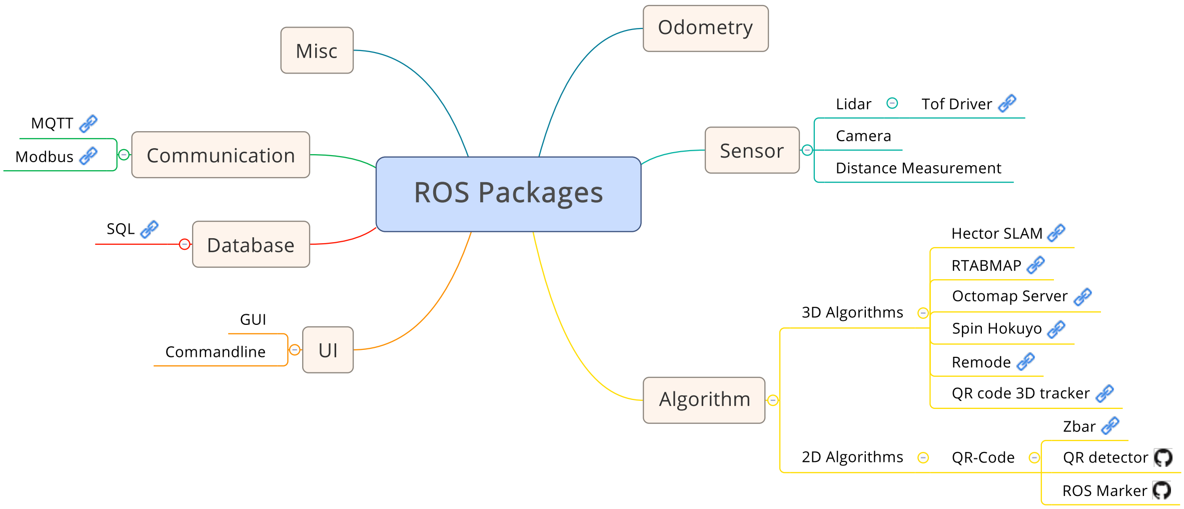


Figure4: ROS Packages Overview

11.10.3 3D Mapping

SLAM

Octomap_server : +

3D occupancy grid mapping, independent from sensor, looks like it does not need odometry

- https://youtu.be/yp0f8-AKvDU
- https://wiki.ros.org/octomap_mapping
- https://wiki.ros.org/octomap_server
- http://octomap.github.io/

Plus :

- maintained
- compatible with melodic
- documentation available as well as many
- no odometry

- independent from hardware (only require the right input topics)

Minus :

- …

Inputs required :

- sensor_msgs/PointCloud2

Hector slam : +

- https://github.com/tu-darmstadt-ros-pkg/hector_slam
- http://wiki.ros.org/hector_slam

Not sure whether we're interested in hector slam itself, or on the

Plus :

- maintained
- not directly compatible with melodic, but easy to build it from source for melodic
- odometry not needed

Minus :

- mostly created for 2D mapping and robot navigation
- not much documentation

Inputs required :

- …

REMODE : ~

- https://www.ros.org/news/2016/02/open-source-release-remode-probabilistic-monocular-dense-rec
  html

modeling of many 3D objects, like rooms, persons, …

Plus :

- noise reduction
- nice rendering

Minus :

- not much documentation and precisions about `hardware/drivers/topics`
- maybe "too much" for our needs ?
- looks like it is not maintained anymore : latest commit was 4 years ago

Inputs :

- …

LOAM

RTABMAP : +

- http://wiki.ros.org/rtabmap_ros

Plus :

- maintained
- compatible with melodic
- real time mapping
- publishes :
  - 3D point clouds
  - 2D occupancy maps
- tutorials and documentation available

Minus :

- oriented towards robot navigation, although “top-down” modeling seems to be possible

Inputs required :

- odometry (not mandatory in all cases)
- scan 2D or 3D

Spin Hokuyo : +

- https://github.com/RobustFieldAutonomyLab/spin_hokuyo
- http://wiki.ros.org/spin_hokuyo

It creates a point cloud with a 2D LiDaR and a servomotor. The interesting node compiles small point clouds to make one big point cloud. Could be very useful to make our digital model.

Plus :

- has a node that compiles point clouds and publish them on a topic
- great rendering

Minus :

- designed for another sensor, but the node that compiles point clouds does not care about that
- need some odometry work

Inputs required :

- laser scan
- odometry

Lego-LOAM : ~

- https://github.com/RobustFieldAutonomyLab/LeGO-LOAM

Plus :

- good rendering

Minus :

- designed for robot navigation, not for "top-down mapping"
- designed for another sensor (velodyne)

Inputs :

- ...

Velodyne loam : ~

- http://wiki.ros.org/loam_velodyne

Plus :

- good rendering
- builds 3D maps

Minus :

- for velodyne sensor
- robot navigation

Inputs :

- ...

Bad solution -

- https://github.com/koide3/hdl_graph_slam : not what we need. creates maps with corridors and doors, but not "top-down" mapping
- http://wiki.ros.org/robot_pose_ekf : not what we need
- http://wiki.ros.org/ethzasl_icp_mapper : doc not up to date, slowly not maintained anymore, ...
- https://github.com/ethz-asl/libpointmatcher/blob/master/doc/index.md

11.10.4 Modbus

- http://wiki.ros.org/modbus

11.10.5 Object Tracking

Multiple objects lidar tracking : ~

- https://github.com/praveen-palanisamy/multiple-object-tracking-lidar

Plus :

- tracks objects in real time
- hardware independent

Minus :

- 2D maps, most likely used for robot navigation

Inputs :

- …

11.10.6 Object Detection

- https://www.acin.tuwien.ac.at/vision-for-robotics/software-tools/v4r-library/
- https://rgit.acin.tuwien.ac.at/v4r/v4r_ros_wrappers
- http://wiki.ros.org/object_recognition
- https://www.osrfoundation.org/ros2-object-detection-demo/
- http://wiki.ros.org/find_object_2d

11.10.7 QR code readers

- http://wiki.ros.org/zbar_ros
- https://github.com/mdrwiega/qr_detector
- http://wiki.ros.org/visp_auto_tracker

11.11 RViz

- *Overview*
- *Run*
- *Built-In Display Types*

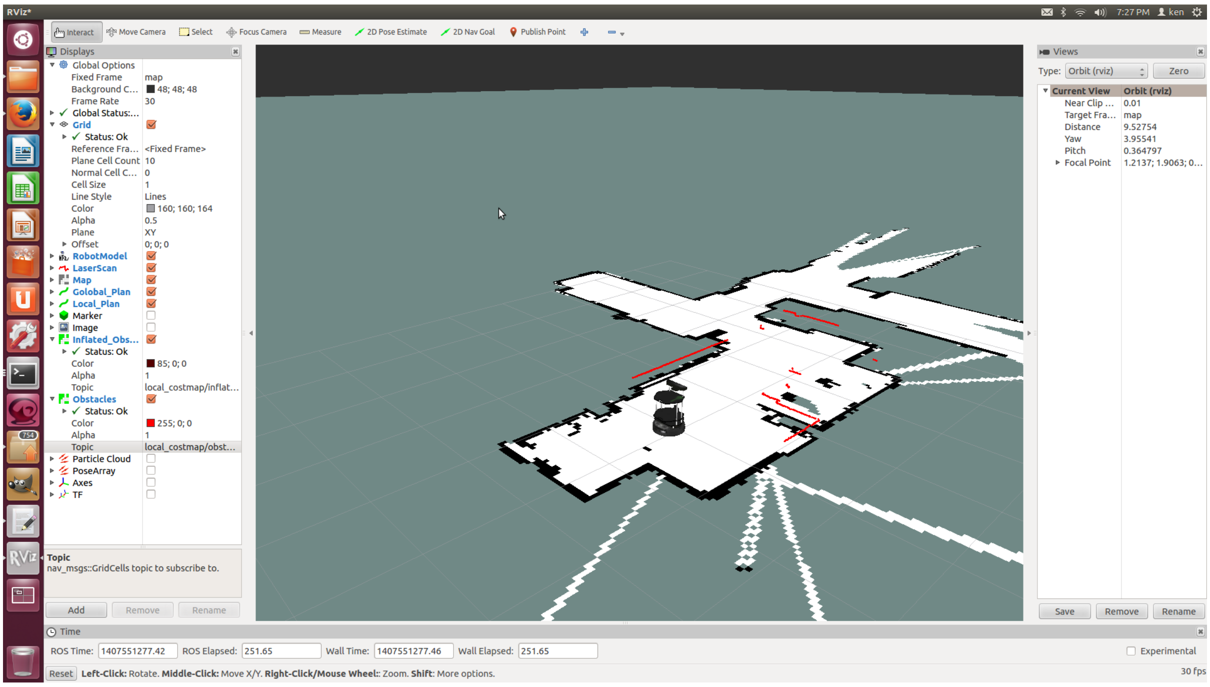
11.11.1 Overview

http://wiki.ros.org/rviz

- 3D visualization tool for ROS
- Subscribes to topics and visualizes the message contents
- Different camera views (orthographic, top-down, etc.)
- Interactive tools to publish user information
- Save and load setup as RViz configuration
- Extensible with plugins

11.11.2 Run

```
rosrun rviz rviz
```



Global Options	
Fixed Frame	map
Background C…	48; 48; 48
Frame Rate	30
✓ Global Status:…	
Grid	☑
✓ Status: Ok	
Reference Fra…	<Fixed Frame>
Plane Cell Count	10
Normal Cell C…	0
Cell Size	1
Line Style	Lines
Color	160; 160; 164
Alpha	0.5
Plane	XY
Offset	0; 0; 0
RobotModel	☑
LaserScan	☑
Map	☑
Golobal_Plan	☑
Local_Plan	☑
Marker	□
Image	□
Inflated_Obs…	☑
✓ Status: Ok	
Color	85; 0; 0
Alpha	1
Topic	local_costmap/inflat…
Obstacles	☑
✓ Status: Ok	
Color	255; 0; 0
Alpha	1
Topic	local_costmap/obst…
Particle Cloud	□
PoseArray	□
Axes	□
TF	□

Topic
nav_msgs::GridCells topic to subscribe to.

Type: Orbit (rviz)

Current View	Orbit (rviz)
Near Clip …	0.01
Target Fra…	map
Distance	9.52754
Yaw	3.95541
Pitch	0.364797
Focal Point	1.2137; 1.9063; 0…

ROS Time: 1407551277.42 ROS Elapsed: 251.65 Wall Time: 1407551277.46 Wall Elapsed: 251.65 □ Experimental

Left-Click: Rotate. **Middle-Click:** Move X/Y. **Right-Click/Mouse Wheel:**: Zoom. **Shift**: More options.

Save configuration with `ctrl+s`

11.11.3 Built-In Display Types

Name	Description	Messages Used
Axes	Displays a set of Axes	
Effort	Shows the effort being put into each revolute joint of a robot.	sensor_msgs/JointStates
Camera	Creates a new rendering window from the perspective of a camera, and overlays the image on top of it.	sensor_msgs/Image, sensor_msgs/CameraInfo
Grid	Displays a 2D or 3D grid along a plane	
Grid Cells	Draws cells from a grid, usually obstacles from a costmap from the navigation stack.	nav_msgs/GridCells
Image	Creates a new rendering window with an Image. Unlike the Camera display, this display does not use a CameraInfo. *Version: Diamondback+*	sensor_msgs/Image
Interactive-Marker	Displays 3D objects from one or multiple Interactive Marker servers and allows mouse interaction with them. *Version: Electric+*	visualization_msgs/InteractiveMarker
Laser Scan	Shows data from a laser scan, with different options for rendering modes, accumulation, etc.	sensor_msgs/LaserScan
Map	Displays a map on the ground plane.	nav_msgs/OccupancyGrid
Markers	Allows programmers to display arbitrary primitive shapes through a topic	visualization_msgs/Marker, visualization_msgs/MarkerArray
Path	Shows a path from the navigation stack.	nav_msgs/Path
Point	Draws a point as a small sphere.	geometry_msgs/PointStamped
Pose	Draws a pose as either an arrow or axes.	geometry_msgs/PoseStamped
Pose Array	Draws a "cloud" of arrows, one for each pose in a pose array	geometry_msgs/PoseArray
Point Cloud(2)	Shows data from a point cloud, with different options for rendering modes, accumulation, etc.	sensor_msgs/PointCloud, sensor_msgs/PointCloud2
Polygon	Draws the outline of a polygon as lines.	geometry_msgs/Polygon
Odometry	Accumulates odometry poses from over time.	nav_msgs/Odometry
Range	Displays cones representing range measurements from sonar or IR range sensors. *Version: Electric+*	sensor_msgs/Range
Robot-Model	Shows a visual representation of a robot in the correct pose (as defined by the current TF transforms).	
TF	Displays the ros wiki tf transform hierarchy.	
Wrench	Draws a wrench as arrow (force) and arrow + circle (torque)	geometry_msgs/WrenchStamped
Oculus	Renders the RViz scene to an Oculus headset	

11.12 Transform Frames

A frame in the ROS language is a specific coordinate system in the space. ROS abstracts elements of a robot as coordinates frames. Each physical part of a robot that has a particular meaning will most likely have its own frame :

- a sensor : *laser_frame*
- an arm : *left_arm_frame*

It is up to the programmer to create frames where it is necessary, but some frames are already defined by ROS (see below).

Each frame has it own origin and coordinate system :

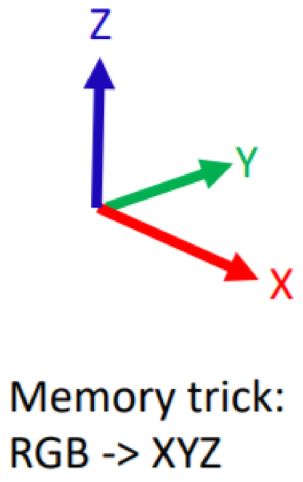


Figure5: coordinate frame axis

To keep trace of the frames in the whole coordinate system, they must all refer to a main frame. Knowing the position of the main frame and the relative positions of all the other frames, ROS is able to know the exact position of each frame all continuously.

The TF2 package tracks the coordinate frames. There are several predefined frames :

- *world* : kind of the parent of all the frames, does not move, there is only one single *world*
- *map* : child of *world*, can be freely fixed in the world frame, does not move compared to the *world*, but it can be several *map* frames in a *world* (usually one *map* per robot)
- *odom* : child of *map*, fixed at the start point of the robot in the *map* frame, does not move compared to *world* and *map*
- *base_link* : kind of the reference frame of a robot, it is moving in *odom*, therefore moving in *map* and *world*
- …

The TF tree shows the relations between the frames :

One can create coordinate frames for each part of the robot that needs to be tracked, for example :

- *scanner_frame* : position of the scanner on a robot, somehow linked to the *base_link*
- *wheels_frame* : position of the wheels on a robot, somehow linked to the *base_link*

The links between the *base_link* and the other frames can be direct, or they can be relative to it via other frames.

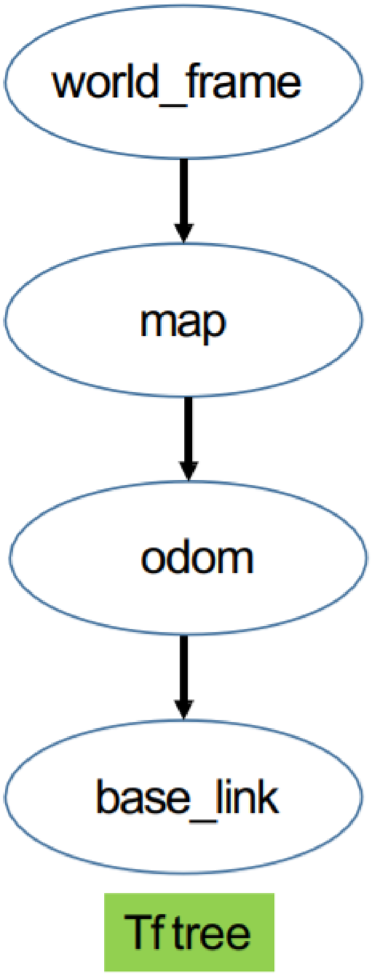


Figure6: tf tree

They are linked together by TF (transform frames). TF can be either static, which means that the relation between two frames will never change (for example two sensors being fixed 1 meter away), or dynamic when the relation evolves in the time (for example the arm of a robot compared to its head).

Let us use the example our two LIDAR sensor : they are oriented in the same way, they are on the same table, the only difference being there is 2.15 meter between them. For this example, they will never move nor rotate. We can use the node *static_transform_publisher* to inform other nodes that will use their data of their relative position. We will also fix them in the *world*, *map* and *base_link* frame.

Since the *base_link* frame will not move neither, it will also be fixed to the *map* by a static transform. The static transformations are called as a node from a launcher :

```
<launch>
      <!-- From world to map, same origin -->
      <node pkg="tf2_ros" type="static_transform_publisher" name="world_to_map"
            args="0 0 0 0 0 0 /world /map" />

      <!-- From map to base_link, fixed in this case -->
      <node pkg="tf2_ros" type="static_transform_publisher" name="map_to_base_link"
            args="0 0 0 0 0 0 /map /base_link" />

      <!-- From base_link to laser_frame1, position of the first lidar -->
      <node pkg="tf2_ros" type="static_transform_publisher" name="base_link_to_
↪lidar1"
            args="0 0 0 0 0 0 /base_link /lidar1_frame" />

      <!-- From base_link to laser_frame2, position of the second lidar -->
      <node pkg="tf2_ros" type="static_transform_publisher" name="base_link_to_
↪lidar2"
            args="-2.15 -0.01 0 0 0 0 /base_link /lidar2_frame" />
</launch>
```

Which will produce the following TF tree :

The arguments are :

- translations in X, Y, Z
- rotations around X, Y, Z
- parent *frame_id*
- child *frame_id*

Each topic has a reference frame. This means that each message being published on a topic kind of contains the position “from where it comes”. This is the *frame_id* parameter. The node that will published the data of the LIDAR shall publish them with the right *frame_id*, otherwise the TF tree will not be able to link all the TF together.

Documentation about frames and transformations can be found there :

- tf2

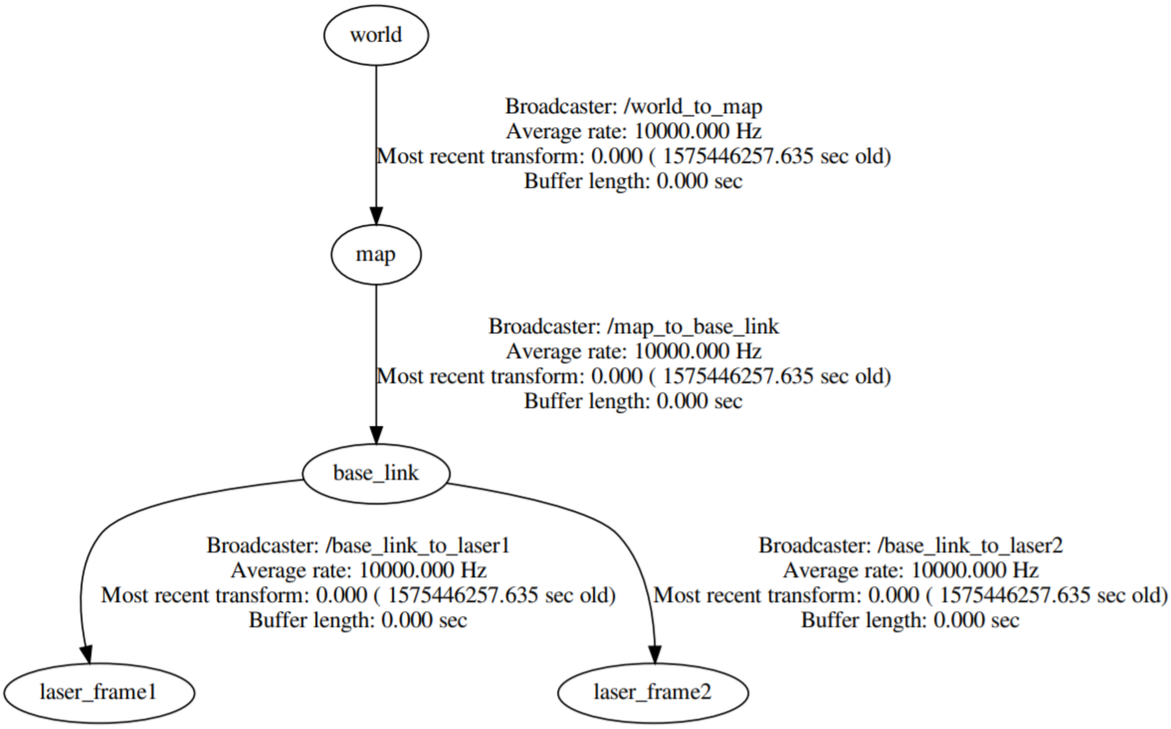

world
Broadcaster: /world_to_map
Average rate: 10000.000 Hz
Most recent transform: 0.000 (1575446257.635 sec old)
Buffer length: 0.000 sec
map
Broadcaster: /map_to_base_link
Average rate: 10000.000 Hz
Most recent transform: 0.000 (1575446257.635 sec old)
Buffer length: 0.000 sec
base_link
Broadcaster: /base_link_to_laser1
Average rate: 10000.000 Hz
Most recent transform: 0.000 (1575446257.635 sec old)
Buffer length: 0.000 sec
Broadcaster: /base_link_to_laser2
Average rate: 10000.000 Hz
Most recent transform: 0.000 (1575446257.635 sec old)
Buffer length: 0.000 sec
laser_frame1
laser_frame2

Figure7: lidar tf tree

Chapter 12

File Headers

```
# filename:          <filename>
# kind:              <type> file
#-------------------------------------------------------------------------------
# History:
# v0.1 : zas <dd.mm.yyyy> -- Initial Version
#-------------------------------------------------------------------------------
# Description:
# <Short Block or file Description>
#-------------------------------------------------------------------------------
# Installation:
# Module     : <Name>
#            : <URL>
#-------------------------------------------------------------------------------
# License:
# This document is under the CC BY-NC-ND 3-0 License,
# Attribution-NonCommercial-NoDerivs 3.0 Unported
# http://creativecommons.org/licenses/by-nc-nd/3.0/
# Copyright (c) tschinz All rights reserved.
#-------------------------------------------------------------------------------
```

```
/**
* For the brave souls who get this far: You are the chosen ones,
* the valiant knights of programming who toil away, without rest,
* fixing our most awful code. To you, true saviors, kings of men,
* I say this: never gonna give you up, never gonna let you down,
* never gonna run around and desert you. Never gonna make you cry,
* never gonna say goodbye. Never gonna tell a lie and hurt you.
*/
```

```
//
// Dear maintainer:
//
// Once you are done trying to 'optimize' this routine,
// and have realized what a terrible mistake that was,
// please increment the following counter as a warning
// to the next guy:
//
// total_hours_wasted_here = 25
//
```

```
//When I wrote this, only God and I understood what I was doing
//Now, God only knows

```

(continues on next page)

(continued from previous page)

```
// drunk, fix later

// Magic. Do not touch.

// I'm sorry.
```

```
/*
 * You may think you know what the following code does.
 * But you dont. Trust me.
 * Fiddle with it, and youll spend many a sleepless
 * night cursing the moment you thought youd be clever
 * enough to "optimize" the code below.
 * Now close this file and go play with something else.
 */
```

```
//I am not sure why this works but it fixes the problem.
```

```
/* Please work */
```

```
// I am not sure if we need this, but too scared to delete.
```

```
//Dear future me. Please forgive me.
//I can't even begin to express how sorry I am.
```

```
// I am not responsible of this code.
// They made me write it, against my will.
```

```
// I have to find a better job
```

```
// TODO: Fix this.  Fix what?
// Any maintenance developer who can't quote entire Monty Python
// movies from memory has no business being a developer.
```

```
// Catching exceptions is for communists
```

```
// and there is where the dragon lives
```

```
// TODO make this work
```

```
//        .==.        .==.
//       //`^\\      //^`\\
//      // ^ ^\(\__/)/^ ^^\\
//     //^ ^^ ^/6  6\ ^^ ^ \\
//    //^ ^^ ^/( .. )\^ ^ ^ \\
//   // ^^ ^/\| v""v |/\^ ^ ^\\
//  // ^^/\/ /  `~~`  \ \/\^ ^\\
//  -----------------------------
/// HERE BE DRAGONS
```

```
// Abandon all hope you who needs to debug this
```

```
// This code was written by a genius so don't try to understand it with
// your tiny little brain.
// BEGIN HACK
// END HACK: I feel dirty.
```

```
//uncomment the following line if the program manager changes her mind again this week
```

```
// If I from the future read this I'll back in time and kill myself.
```

```
// Choose! Choose the form of the Destructor!
// The choice is made! The Traveler has come!
```

```
/* You are not expected to understand this. */
```

```
// but the "real" solution is much more complicated
```

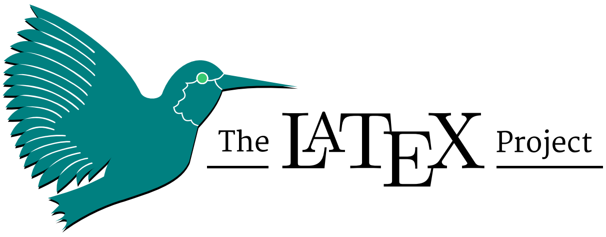
```
// It may be a hack, but it works.
```

```
//user the force, luke
```

```
// need a coffee to fix this.
```

Chapter 13

LaTeX



13.1 Introduction

- *Some LaTeX helppages*
- *Generate PDF files*

13.1.1 Some LaTeX helppages

- HEI SPL Latex Templates
- Cheatsheet A Guide to Latex
- Tex Stackexchange Forum

13.1.2 Generate PDF files

Latex is best suited to insert images as pdf. In order to convert images or svg into pdf use inkscape Convert `*.svg` images with inkscape to `*.pdf` and `*.pdf_tex`

```
inkscape -D -z --file=image.svg --export-pdf=image.pdf --export-latex
```

13.2 Installation LaTeX

- *Base Install*
  - *Linux*
  - *Windows*
- *Manual Package install*
  - *Manual Package Linux*
  - *Manual Package Windows*

13.2.1 Base Install

Linux

Package	Archives	Disk Space
texlive-latex-base	59 MB	216 MB
texlive-latex-recommended	74 MB	248 MB
texlive-pictures	83 MB	277 MB
texlive-fonts-recommended	83 MB	281 MB
texlive	98 MB	314 MB
texlive-plain-generic	82 MB	261 MB
texlive-latex-extra	144 MB	452 MB
texlive-full	2804 MB	5358 MB

see also Tex Stack Exchange

```
                      texlive-latex-extra
                         |   |   :   :
       +-----------------+   |   :   :..................
       |                     |   :                     :
       v                     |   :                     v
texlive-pictures             |   :           texlive-plain-generic
       |                     |   :
       |    +----------------+   :...............
       |    |                                   :
       |    |              texlive              :
       |    |               | | |               :
       |    |    +----------+ | +----------+    :
       |    |    |            |            |    :
       v    v    v            |            v    v
texlive-latex-recommended     |  texlive-fonts-recommended
                 |            |            :
                 |            |            v
                 |            |           tipa
                 |            |            |
                 +----------+ | +----------+
                            | | |
                            v v v
                     texlive-latex-base
```

```
sudo apt-get install texlive-latex-extra
```

Windows

- Install MikTeX - https://miktex.org/download
- MikTeX Packages
  - minted

    ```
    pip install pygments
    ```

    add Python Scripts to PATH Environment Variable. `%USERPROFILE%\AppData\Local\Continuum\anaconda3\Scripts\`
- Install TeXstudio
  - https://texstudio.org
  - Options => Configure TeXstudio => Commands => add Interpreter Flag `-shell-escape`
  - enable line numbers
  - enable white spaces
- Install Inkscape
  - https://inkscape.org/release/

13.2.2 Manual Package install

For manual installing `*.sty` Packages and `*.cls` Class files.

> **Warning:** For every package create a separate folder

Manual Package Linux

- Find `TEXMFHOME` directory

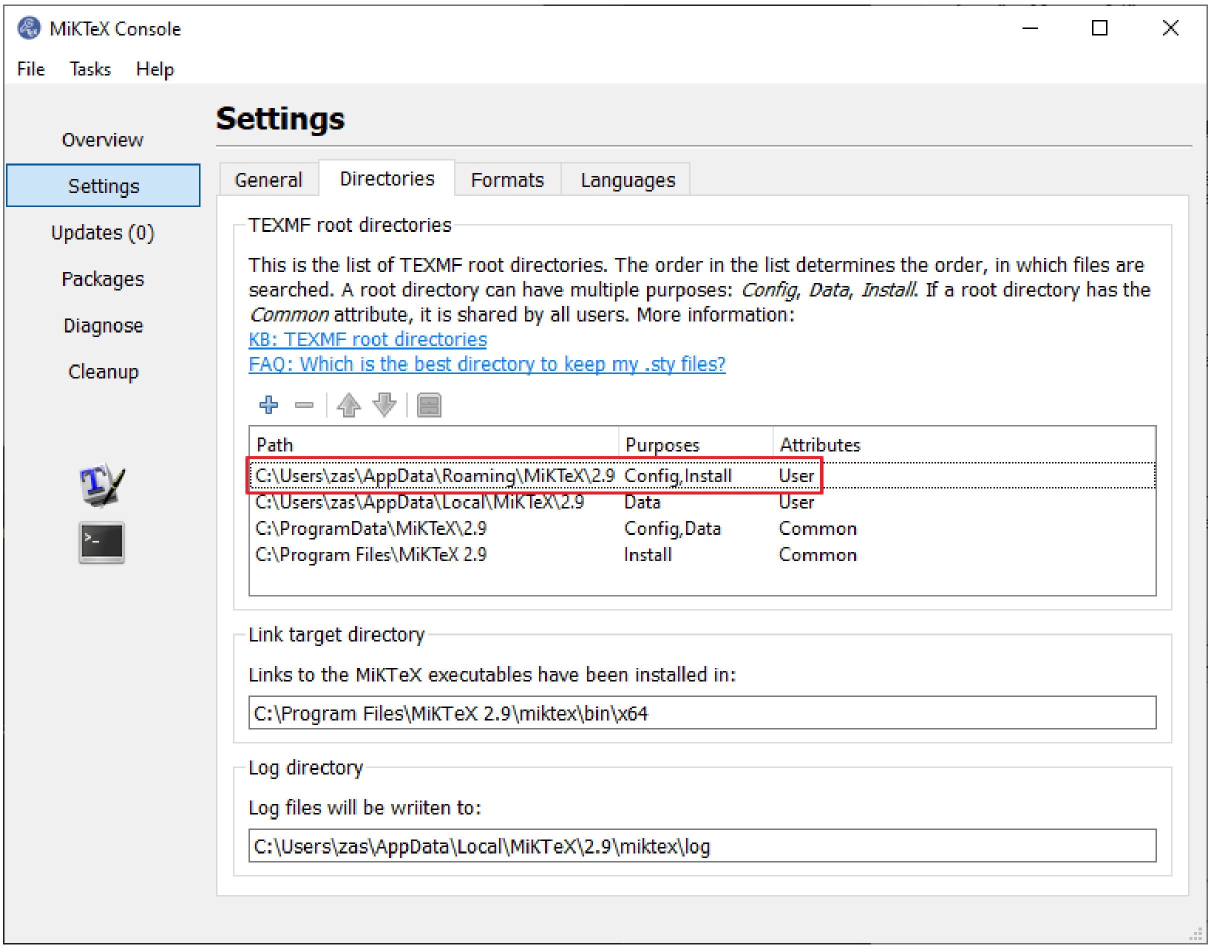
  ```
  kpsewhich -var-value TEXMFHOME
  ```

- Navigate to `$(TEXMFHOME)/tex/latex`
- Copy paste your `*.sty` and `*.cls`
- Update Package index

  ```
  texhash
  ```

Manual Package Windows

- Open MikTeX Console and go to `Settings -> Directories`
- The `Config,Install` and `User` folder is the location of your Packages: `%USERPROFILES%/AppData/Roaming/MikTeX/2.9/`
- Inside you have to navigate to `tex/latex/` folder
- `%USERPROFILES%/AppData/Roaming/MikTeX/2.9/tex/latex/`
- Copy paste your `*.sty` and `*.cls`



Settings

TEXMF root directories

This is the list of TEXMF root directories. The order in the list determines the order, in which files are searched. A root directory can have multiple purposes: *Config, Data, Install*. If a root directory has the *Common* attribute, it is shared by all users. More information:

KB: TEXMF root directories

FAQ: Which is the best directory to keep my .sty files?

Path	Purposes	Attributes
C:\Users\zas\AppData\Roaming\MiKTeX\2.9	Config,Install	User
C:\Users\zas\AppData\Local\MiKTeX\2.9	Data	User
C:\ProgramData\MiKTeX\2.9	Config,Data	Common
C:\Program Files\MiKTeX 2.9	Install	Common

Link target directory

Links to the MiKTeX executables have been installed in:

C:\Program Files\MiKTeX 2.9\miktex\bin\x64

Log directory

Log files will be wriiten to:

C:\Users\zas\AppData\Local\MiKTeX\2.9\miktex\log

- Update Package index

  ```
  texhash
  ```

Chapter 14

ReStructuredText

14.1 Introduction

- *Some RST Syntax helppages*

14.1.1 Some RST Syntax helppages

- `rst-cheatsheet.pdf`
- Thomas Cokelaer RST Sphinx Syntax
- Docutil Quickref
- Raslina RST Cheatsheet

14.2 RST and Sphinx Cheatsheet

In this page you will get a quick overview about the most used syntax.

- *Table of content*
- *Titles*
- *Markup*
- *Links*
    - *External Links*
        - *Internet*
        - *Other Repo's*
        - *Other Sphinx Pages*
    - *Internal Links*
        - *Link to Titles*
        - *Internal References*

        - *File Links*
- *Images*
    - *Image Placement*
    - *Inline Images*
- *Lists*
- *Tables*
- *Code*
- *Infoboxes*
- *Special Formatting*
- *Math*
- *Exclude*
- *GraphViz*
- *Wavedrom*
    - *Timing Diagrams*
    - *Register*
- *PlantUML*

14.2.1 Table of content

To include a table of content of all title in a page use

```
.. contents:: :local:
```

14.2.2 Titles

The lines have to be as long or longer than the text.

```
=============
Section Title
=============

Titles
======

Paragraph
---------

Sub-Pragraph
^^^^^^^^^^^^
```

14.2.3 Markup

emphasis	*emphasis*
strong emphasis	**strong emphasis**
`interpreted text`	The rendering and meaning of interpreted text is domain- or application-dependent.
``inline literal``	inline literal
:markup:	**markup**
> quote markup	> quote markup

14.2.4 Links

External Links

Internet

```
`python <http://www.python.org/>`_
`<http://www.python.org/>`_
http://www.python.org/
```

python

http://www.python.org/

http://www.python.org/

Other Repo's

The plugin 'sphinx.ext.extlinks allows creating shortcuts

```
extlinks = {'config_
↪repo': ('https://github.com/tschinz/config/%s', None),
            'zawiki_
↪repo': ('https://github.com/tschinz/zawiki/%s', None)
           }
```

```
:config_repo:`jupyter config <tree/master/config/jupyter>`
:zawiki_repo:`zawiki link <>`
```

jupyter config zawiki link

Other Sphinx Pages

- absolute link from root *About*
- relative link from document location *About*

```
* absolute link from root
  :doc:`/about/index`

* relative link from document location
  :doc:`../../about/index`
```

In order to link to another subheader in another document you need to use *Internal References*.

In the page to be jumped to add `.. _ref_name:`, and then you can:

```
:ref:`ref_name`
:ref:`link title<ref_name>`
```

Like so:

- *How to use Sphinx Documentation*
- *Sphinx Doc Link*

Internal Links

Link to Titles

Link to titles directly is done with the extension `sphinx.ext.autosectionlabel`.

Important: You need to add the `folder_name` and `subfolder(s)`_name` name as well as `file_name` without `.rst` extension in order to reference a section title. This avoids the duplicated label warning.

```
:ref:`Displayname␣
↪<folder_name/subfolder_name/file_name/section_title>`
```

```
:ref:`Back␣
↪to top <writing/rst/cheatsheet:RST and Sphinx Cheatsheet>`

:ref:`writing/rst/cheatsheet:Images`
```

Back to top

Images

Internal References

In any place of the document a reference point can be inserted and later refered to.

```
.. _ref-point:

see :ref:`ref-point`
```

see *Internal References*

File Links

To link to a file within the Sphinx file structure use the Role `:download:`

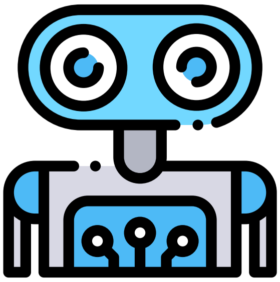
```
:download:`../../coding/
↪ros/books/Mastering_ROS_for_Robotics_Programming.pdf`

:download:`Mastering_
↪ROS_for_Robotics_Programming <../../coding/
↪ros/books/Mastering_ROS_for_Robotics_Programming.pdf>`
```

`../../coding/ros/books/Mastering_ROS_for_Robotics_Programming.pdf`

`Mastering_ROS_for_Robotics_Programming`

14.2.5 Images

```
.. figure:: /img/logo.*
```

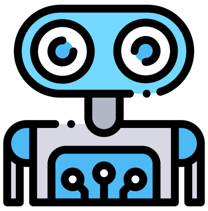


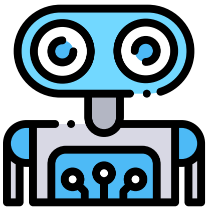
Important: Images should be either in `png` or `svg` format

Important: For `*.svg` files the file ending needs to be changed from `svg` to `*`. That way for html svg is used and pdf or pn for the latex or pdf output.

Image Placement

```
.. figure:: /img/logo.*
   :align: left
   :width: 100px

.. figure:: /img/logo.*
   :align: center
   :width: 100px

.. figure:: /img/logo.*
   :align: right
   :width: 100px

.. figure:: /img/logo.*
   :align: center
   :width: 100px
   :height: 100px
   :scale: 50 %
   :alt: this is the knowhow logo

   Caption of figure
```





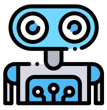
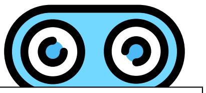


Figure1: Caption of figure

Inline Images

For inline images to work, a substitution needs to be made



```
.. |folder_icon| image:: /img/icons/folder.*

After that the image |folder_icon| can be integrated inline.
```

After that the image 📁 can be integrated inline.

14.2.6 Lists

- item 1
  - item 1.1
  - item 1.2
- item 2
  - item 2.1
    - item 2.1.1

1. auto enumerated list item 1
2. auto enumerated list item 1
3. auto enumerated list item 1
4. auto enumerated list item 1

3. enumerated list start with item 3
4. auto enumerated list item 4
5. auto enumerated list item 5
6. auto enumerated list item 6

14.2.7 Tables

```
+------------+-----------+----------+
| Header 1   | Header 2   | Header 3  |
+============+===========+==========+
| body row 1 | column 2   | column 3  |
+------------+-----------+----------+
| body row 2 | Cells may span columns.|
+------------+-----------+----------+
| body row 3 | Cells may  | - Cells   |
+------------+ span rows. | - contain |
| body row 4 |            | - blocks. |
+------------+-----------+----------+
```

Header 1	Header 2	Header 3
body row 1	column 2	column 3
body row 2	Cells may span columns.	
body row 3	Cells may span rows.	• Cells • contain • blocks.
body row 4		

```
=====  =====  ======
Inputs     Output
------------  ------
  A      B    A or B
=====  =====  ======
False  False  False
True   False  True
False  True   True
True   True   True
=====  =====  ======
```

Inputs		Output
A	B	A or B
False	False	False
True	False	True
False	True	True
True	True	True

```
.. list-table::
   :header-rows: 1
   :widths: 1 1 2

   * - Type
     - Literal
     - Description
   * - Boolean
     - true, false
     -
   * - Int
     - 3, 0x32
     - 32 bits integer
   * - Float
     - 3.14f
     - 32 bits floating point
   * - Double
     - 3.14
     - 64 bits floating point
   * - String
     - "Hello world"
     - UTF-16 string
```

Type	Literal	Description
Boolean	true, false	
Int	3, 0x32	32 bits integer
Float	3.14f	32 bits floating point
Double	3.14	64 bits floating point
String	“Hello world”	UTF-16 string

```
.. table:: Table caption

   =====  =====  ======
      Inputs     Output
   ------------  ------
     A      B    A or B
   =====  =====  ======
   False  False  False
   =====  =====  ======
```

Table1: Table caption

Inputs		Output
A	B	A or B
False	False	False

14.2.8 Code

see also: https://build-me-the-docs-please.readthedocs.io/en/latest/Using_Sphinx/ShowingCodeExamplesInSphinx.html and https://pygments.org/languages/

```
.. code-block:: python

   import antigravity

   def main():
       antigravity.fly()
   if __name__=='__main__':
       main()
```

```
import antigravity

def main():
    antigravity.fly()
if __name__=='__main__':
    main()
```

```
.. code-block:: python
   :linenos:
   :caption: Code Blocks can have captions.

   import antigravity

   def main():
       antigravity.fly()
   if __name__=='__main__':
       main()
```

Listing 1: Code Blocks can have captions.

```
import antigravity

def main():
    antigravity.fly()
if __name__=='__main__':
    main()
```

```
.. code-block:: python
   :linenos:
   :lineno-start: 10

   import antigravity

   def main():
       antigravity.fly()
   if __name__=='__main__':
       main()
```

```
import antigravity

def main():
    antigravity.fly()
if __name__=='__main__':
    main()
```

14.2.9 Infoboxes

```
.. note::
   This is a Note Box
```

Note: This is a Note Box

```
.. warning::
   This is a Warning Box
```

Warning: This is a Warning Box

```
.. important::
   This is a Important Box
```

Important: This is a Important Box

```
.. seealso::
   This is a See Also Box
```

See also:

This is a See Also Box

14.2.10 Special Formatting

```
.. versionadded:: 2.5
   The *spam* parameter.

.. versionchanged:: 2.5
   Feature description

.. deprecated:: 3.1
   Use :func:`spam` instead.
```

New in version 2.5: The *spam* parameter.

Changed in version 2.5: Feature description

Deprecated since version 3.1: Use `spam()` instead.

14.2.11 Math

```
Inline math :math:`a^2 + b^2 = c^2`.
```

Inline math $a^2 + b^2 = c^2$.

```
.. math::

   f(x) &= x^2\\
   g(x) &= \frac{1}{x}\\
   F(x) &= \int^a_b \frac{1}{3}x^3
```

$$
\begin{aligned}
f(x) &= x^2 \\
g(x) &= \frac{1}{x} \\
F(x) &= \int_b^a \frac{1}{3}x^3
\end{aligned}
$$

14.2.12 Exclude

In order to exclude some parts for a certain output use the `.. only:: output` directive.

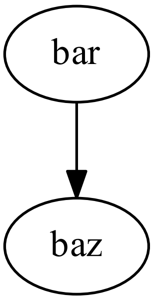
```
.. only:: html
.. only:: draft
.. only:: latex
.. only:: html or draft or latex
.. only:: html and draft
```

Important: This is needed for the all the *Wavedrom* code

14.2.13 GraphViz

Get more samples herer: https://graphviz.gitlab.io/gallery/

```
.. graphviz::

   digraph foo {
      "bar" -> "baz";
   }
```

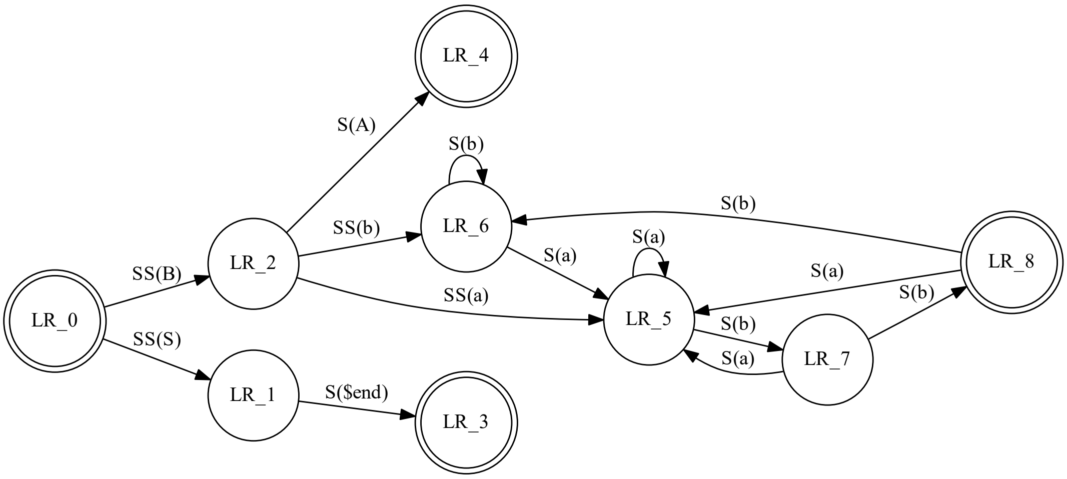


```
.. graphviz::

   digraph finite_state_machine {
     rankdir=LR;
     size="8,5"
     node [shape = doublecircle]; LR_0 LR_3 LR_4 LR_8;
     node [shape = circle];
     LR_0 -> LR_2 [ label = "SS(B)" ];
     LR_0 -> LR_1 [ label = "SS(S)" ];
```

(continues on next page)

(continued from previous page)

```
    LR_1 -> LR_3 [ label = "S($end)" ];
    LR_2 -> LR_6 [ label = "SS(b)" ];
    LR_2 -> LR_5 [ label = "SS(a)" ];
    LR_2 -> LR_4 [ label = "S(A)" ];
    LR_5 -> LR_7 [ label = "S(b)" ];
    LR_5 -> LR_5 [ label = "S(a)" ];
    LR_6 -> LR_6 [ label = "S(b)" ];
    LR_6 -> LR_5 [ label = "S(a)" ];
    LR_7 -> LR_8 [ label = "S(b)" ];
    LR_7 -> LR_5 [ label = "S(a)" ];
    LR_8 -> LR_6 [ label = "S(b)" ];
    LR_8 -> LR_5 [ label = "S(a)" ];
  }
```



14.2.14 Wavedrom

For more information see:

- Wavedrom JSON Wiki
- Wavedrom Tutorial

Timing Diagrams

This documentation makes use of the `sphinxcontrib-wavedrom` plugin, So you can specify a timing diagram, or a register description with the `WaveJSON` syntax like so:

```
.. wavedrom::

    { "signal": [
      { "name": "pclk", "wave": 'p.......' },
      { "name": "Pclk", "wave": 'P.......' },
      { "name": "nclk", "wave": 'n.......' },
      { "name": "Nclk", "wave": 'N.......' },
      {},
```

(continues on next page)

(continued from previous page)

```
      { "name": 'clk0', "wave": 'phnlPHNL' },
      { "name": 'clk1', "wave": 'xhlhLHl.' },
      { "name": 'clk2', "wave": 'hpHplnLn' },
      { "name": 'clk3', "wave": 'nhNhplPl' },
      { "name": 'clk4', "wave": 'xlh.L.Hx' },
   ]}
```

and you get:

Note: if you want the Wavedrom diagram to be present in the pdf export, you need to use the “non relaxed” JSON dialect. long story short, no javascript code and use " arround key value (Eg. "name").

Register

you can describe register mapping with the same syntax:

```
{"reg":[
  {"bits": 8, "name": "things"},
  {"bits": 2, "name": "stuff" },
  {"bits": 6},
 ],
 "config": { "bits":16,"lanes":1 }
 }
```

14.2.15 PlantUML

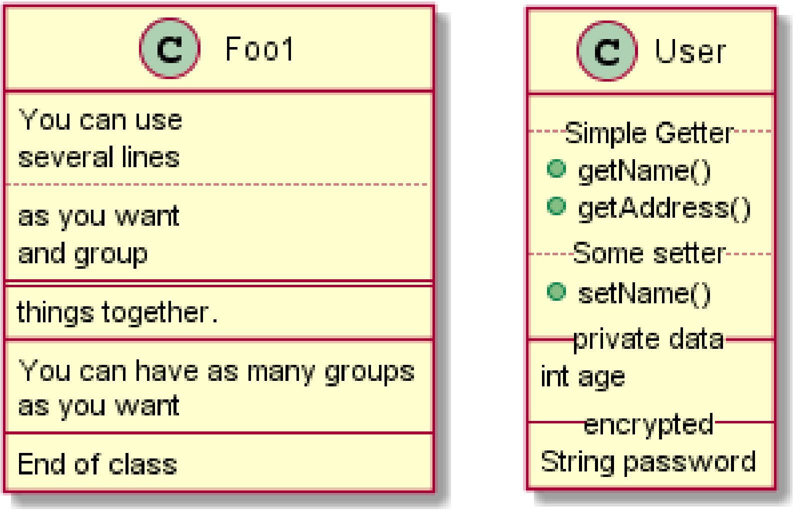
This documentation makes use of the `sphinxcontrib.plantuml` plugin, for more information see the sphinxcontrib.plantuml plugin and the PlantUML Webpage. For a small Cheatsheet for PlantUML see https://ogom.github.io/draw_uml/plantuml/

```
.. uml::

   class Foo1 {
     You can use
     several lines
     ..
     as you want
     and group
     ==
     things together.
     __
     You can have as many groups
     as you want
     --
     End of class
   }

   class User {
     .. Simple Getter ..
     + getName()
     + getAddress()
     .. Some setter ..
     + setName()
```

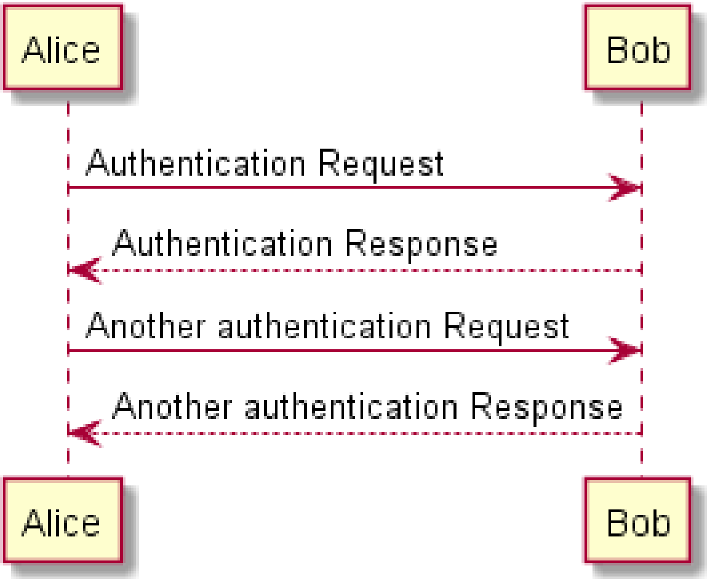
(continues on next page)

(continued from previous page)

```
     __ private data __
     int age
     -- encrypted --
     String password
   }
```



```
.. uml::

   Alice -> Bob: Authentication Request
   Bob --> Alice: Authentication Response

   Alice -> Bob: Another authentication Request
   Alice <-- Bob: Another authentication Response
```

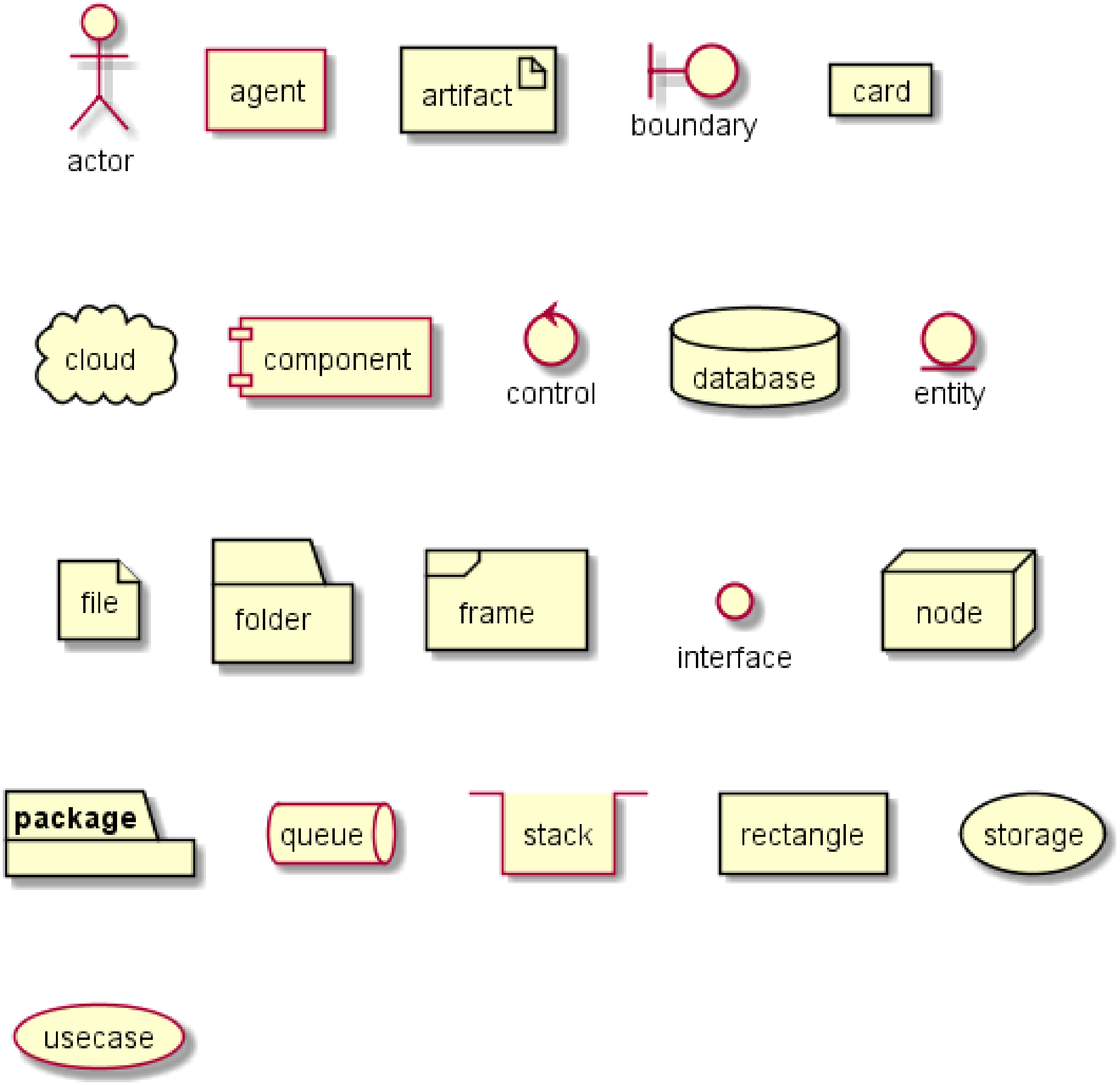

Alice
Bob
Authentication Request
Authentication Response
Another authentication Request
Another authentication Response
Alice
Bob

```
.. uml::

   actor actor
   agent agent
   artifact artifact
   boundary boundary
   card card
```

(continues on next page)

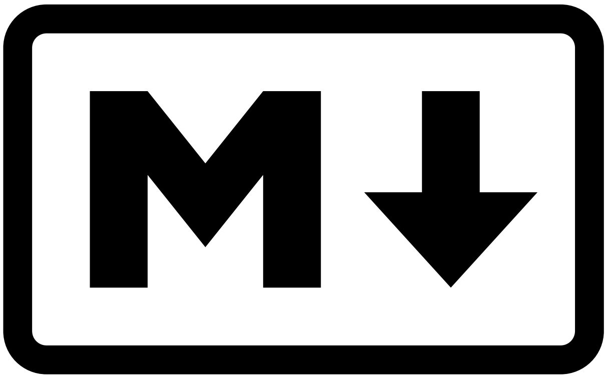
(continued from previous page)

```
    cloud cloud
    component component
    control control
    database database
    entity entity
    file file
    folder folder
    frame frame
    interface  interface
    node node
    package package
    queue queue
    stack stack
    rectangle rectangle
    storage storage
    usecase usecase
```



Chapter 15

Markdown



15.1 Github Markdown

See also my git :config_repo:`css themes <tree/master/scripts/md>` in the config repo

GFM is a variant of markdown developed by Github.

- https://help.github.com/articles/github-flavored-markdown
- https://github.com/adam-p/markdown-here/wiki/Markdown-Cheatsheet This is intended as a quick reference and showcase. For more complete info, see John Gruber's original spec and the Github-flavored Markdown info page.

15.1.1 Table of Contents

Headers Emphasis Lists Links Images Code and Syntax Highlighting Tables Blockquotes Inline HTML Horizontal Rule Line Breaks YouTube Videos

15.1.2 Headers

```
# H1
## H2
### H3
#### H4
##### H5
###### H6

Alternatively, for H1 and H2, an underline-ish style:

Alt-H1
======

Alt-H2
------
```

15.2 H1

15.2.1 H2

H3

H4

H5

H6

Alternatively, for H1 and H2, an underline-ish style:

15.2.2 Emphasis

```
Emphasis, aka italics, with *asterisks* or _underscores_.

Strong emphasis, aka bold, with **asterisks** or __underscores__.

Combined emphasis with **asterisks and _underscores_**.

Strikethrough uses two tildes. ~~Scratch this.~~
```

Emphasis, aka italics, with *asterisks* or *underscores*.

Strong emphasis, aka bold, with **asterisks** or **underscores**.

Combined emphasis with **asterisks and *underscores***.

Strikethrough uses two tildes. ~~Scratch this.~~

15.2.3 Lists

```
1. First ordered list item
2. Another item
  * Unordered sub-list.
1. Actual numbers don't matter, just that it's a number
  1. Ordered sub-list
4. And another item.

   You can have properly indented paragraphs within list items. Notice the blank␣
↪line above, and the leading spaces (at least one, but we'll use three here to␣
↪also align the raw Markdown).

   To have a line break without a paragraph, you will need to use two trailing␣
↪spaces.
   Note that this line is separate, but within the same paragraph.
   (This is contrary to the typical GFM line break behaviour, where trailing␣
↪spaces are not required.)

* Unordered list can use asterisks
- Or minuses
+ Or pluses
```

1. First ordered list item
2. Another item
  - Unordered sub-list.
1. Actual numbers don't matter, just that it's a number
2. Ordered sub-list
3. And another item.

   You can have properly indented paragraphs within list items. Notice the blank line above, and the leading spaces (at least one, but we'll use three here to also align the raw Markdown).

   To have a line break without a paragraph, you will need to use two trailing spaces. Note that this line is separate, but within the same paragraph. (This is contrary to the typical GFM line break behaviour, where trailing spaces are not required.)

- Unordered list can use asterisks
- Or minuses
- Or pluses

15.2.4 Links

There are two ways to create links.

```
[I'm an inline-style link](https://www.google.com)

[I'm an inline-style link with title](https://www.google.com "Google's Homepage")

[I'm a reference-style link][Arbitrary case-insensitive reference text]

[I'm a relative reference to a repository file](../blob/master/LICENSE)

[You can use numbers for reference-style link definitions][1]

```

(continues on next page)

(continued from previous page)

```
Or leave it empty and use the [link text itself].

URLs and URLs in angle brackets will automatically get turned into links.
http://www.example.com or <http://www.example.com> and sometimes
example.com (but not on Github, for example).

Some text to show that the reference links can follow later.

[arbitrary case-insensitive reference text]: https://www.mozilla.org
[1]: http://slashdot.org
[link text itself]: http://www.reddit.com
```

I'm an inline-style link

I'm an inline-style link with title

I'm a reference-style link

```
[I'm a relative reference to a repository file]("../../../README.md")
```

You can use numbers for reference-style link definitions

Or leave it empty and use the link text itself.

URLs and URLs in angle brackets will automatically get turned into links. http://www.example.com or http://www.example.com and sometimes example.com (but not on Github, for example).

Some text to show that the reference links can follow later.

15.2.5 Images

```
Here's our logo (hover to see the title text):

Inline-style:
![alt text](https://github.com/adam-p/markdown-here/raw/master/src/common/images/
↪icon48.png "Logo Title Text 1")

Reference-style:
![alt text][logo]

[logo]: https://github.com/adam-p/markdown-here/raw/master/src/common/images/
↪icon48.png "Logo Title Text 2"
```

Here's our logo (hover to see the title text):

Inline-style:

Reference-style:

15.2.6 Code and Syntax Highlighting

Code blocks are part of the Markdown spec, but syntax highlighting isn't. However, many renderers – like Github's and *Markdown Here* – support syntax highlighting. Which languages are supported and how those language names should be written will vary from renderer to renderer. *Markdown Here* supports highlighting for dozens of languages (and not-really-languages, like diffs and HTTP headers); to see the complete list, and how to write the language names, see the highlight.js demo page.

```
Inline `code` has `back-ticks around` it.
```

Inline `code` has `back-ticks around` it.

Blocks of code are either fenced by lines with three back-ticks "', or are indented with four spaces. I recommend only using the fenced code blocks – they're easier and only they support syntax highlighting.

```
var s = "JavaScript syntax highlighting";
alert(s);
```

```
s = "Python syntax highlighting"
print s
```

```
No language indicated, so no syntax highlighting in Markdown Here (varies on Github).
But let's throw in a <b>tag</b>.
```

15.2.7 Tables

Tables aren't part of the core Markdown spec, but they are part of GFM and *Markdown Here* supports them. They are an easy way of adding tables to your email – a task that would otherwise require copy-pasting from another application.

```
Colons can be used to align columns.

| Tables        | Are           | Cool  |
| ------------- |:-------------:| -----:|
| col 3 is      | right-aligned | $1600 |
| col 2 is      | centered      |   $12 |
| zebra stripes | are neat      |    $1 |

There must be at least 3 dashes separating each header cell.
The outer pipes (|) are optional, and you don't need to make the
raw Markdown line up prettily. You can also use inline Markdown.

Markdown | Less | Pretty
--- | --- | ---
*Still* | `renders` | **nicely**
1 | 2 | 3
```

Colons can be used to align columns.

| Tables | Are | Cool | | ————- |:————-:| —-:| | col 3 is | right-aligned | $1600 | | col 2 is | centered | $12 | | zebra stripes | are neat | $1 |

There must be at least 3 dashes separating each header cell. The outer pipes (|) are optional, and you don't need to make the raw Markdown line up prettily. You can also use inline Markdown.

Markdown | Less | Pretty — | — | — *Still* | `renders` | **nicely** 1 | 2 | 3

15.2.8 Blockquotes

```
> Blockquotes are very handy in email to emulate reply text.
> This line is part of the same quote.

Quote break.

> This is a very long line that will still be quoted properly when it wraps. Oh␣
↪boy let's keep writing to make sure this is long enough to actually wrap for␣
↪everyone. Oh, you can *put* **Markdown** into a blockquote.
```

> Blockquotes are very handy in email to emulate reply text. This line is part of the same quote.

Quote break.

> This is a very long line that will still be quoted properly when it wraps. Oh boy let's keep writing to make sure this is long enough to actually wrap for everyone. Oh, you can *put* **Markdown** into a blockquote.

15.2.9 Inline HTML

You can also use raw HTML in your Markdown, and it'll mostly work pretty well.

```
<dl>
  <dt>Definition list</dt>
  <dd>Is something people use sometimes.</dd>

  <dt>Markdown in HTML</dt>
  <dd>Does *not* work **very** well. Use HTML <em>tags</em>.</dd>
</dl>
```

15.2.10 Horizontal Rule

```
Three or more...

---

Hyphens

***

Asterisks

___

Underscores
```

Three or more...

Hyphens

Asterisks

Underscores

15.2.11 Line Breaks

My basic recommendation for learning how line breaks work is to experiment and discover – hit <Enter> once (i.e., insert one newline), then hit it twice (i.e., insert two newlines), see what happens. You'll soon learn to get what you want. "Markdown Toggle" is your friend.

Here are some things to try out:

```
Here's a line for us to start with.

This line is separated from the one above by two newlines, so it will be a␣
↪*separate paragraph*.

This line is also a separate paragraph, but...
This line is only separated by a single newline, so it's a separate line in the␣
↪*same paragraph*.
```

Here's a line for us to start with.

This line is separated from the one above by two newlines, so it will be a *separate paragraph*.

This line is also begins a separate paragraph, but... This line is only separated by a single newline, so it's a separate line in the *same paragraph*.

(Technical note: *Markdown Here* uses GFM line breaks, so there's no need to use MD's two-space line breaks.)

15.2.12 YouTube Videos

They can't be added directly but you can add an image with a link to the video like this:

```
<a href="http://www.youtube.com/watch?feature=player_embedded&v=YOUTUBE_VIDEO_ID_
↪HERE
" target="_blank"><img src="http://img.youtube.com/vi/YOUTUBE_VIDEO_ID_HERE/0.jpg"
alt="IMAGE ALT TEXT HERE" width="240" height="180" border="10" /></a>
```

Or, in pure Markdown, but losing the image sizing and border:

```
[![IMAGE ALT TEXT HERE](http://img.youtube.com/vi/YOUTUBE_VIDEO_ID_HERE/0.
↪jpg)](http://www.youtube.com/watch?v=YOUTUBE_VIDEO_ID_HERE)
```

Referencing a bug by #bugID in your git commit links it to the slip. For example #1.

Chapter 16

Multimedia

🙈🙉🙊

16.1 Book Review

A list of my favorite books

16.1.1 Crime

Stieg Larsson

- Millenium Trilogie 🇨🇭⭐⭐⭐⭐⭐
- Verblendung
- Verdammnis
- Vergebung

Jo Nesbø

- Die Fährte ⭐⭐⭐
- Headhunter ⭐⭐⭐

Peter James

- Nicht tot genug ★ 🇨🇭
- Stirb ewig ★ 🇨🇭

Mo Hayder

- Der Vogelmann 🇨🇭 ★★

Arne Dahl

- Gier 🇨🇭 ★

Adler Olsen

- Erlösung 🇨🇭 ★★

16.1.2 Science-Fiction

H.R.Wells

- The Invisible Man 🇬🇧 ★★★

Alan Dean Forster

- The Dig 🇬🇧 ★★★★

Neal Asher

- Departure 🇬🇧 ★★★

Michael Crinchton

- Prey 🇬🇧 ★★★★★
- State of fear 🇬🇧 ★★★★
- Dino Park 🇬🇧 ★★
- Timeline 🇬🇧 ★★★★
- Enthüllung 🇨🇭 ★★

- Gold - Pirate Latitues ★★★
- The Lost Word 🇬🇧 ★★★
- Next 🇬🇧 ★★
- Micro 🇨🇭 ★★★★★

Douglas Adams

- Per Anhalter durch die Galaxis
- Machs gut und Danke für den Fisch
- Restaurant am Edne des Univers

16.1.3 Biography

- Edward Snowden - Permanent Record 🇬🇧 ★★★★
- Steve Jobs - Walter Isaacson 🇬🇧 ★★★
- Leonardo Da Vinci - Walter Isaacson 🇬🇧 ★★★★
- Elon Musk - Alex Whitestone 🇬🇧 ★★

16.2 Programmer Jokes

- *Christmas and Halloween*
- *10 Kind of People*
- *Error Free Programs*
- *Boolean Answer*
- *Programmer Checks*
- *Debugging*
- *HTML Tags*
- *Teacher Punishement*
- *Accelerate a computer*

16.2.1 Christmas and Halloween

Question Why do programmers always mix up Halloween and Christmas?

Answer

- 31 Dec Christmas
- 25 Okt Halloween

16.2.2 10 Kind of People

Question

There are `10` types of people in this world. Those who understand binary and those who don't.

Answer `0b10 = 2`

16.2.3 Error Free Programs

Question There are two ways to write error-free programs; only the third one works.

Answer There is no error free program, therefore the anwer is also wrong

16.2.4 Boolean Answer

Question The best thing about a Boolean is even if you are wrong, you are only off by a bit.

Answer Boolean = `0` or `1` only of by 1bit

16.2.5 Programmer Checks

Question A good programmer is someone who always looks both ways before crossing a one-way street.

Answer Programmers can't make assumptions, they have to check everything

16.2.6 Debugging

Question Debugging: Removing the needles from the haystack.

Answer Debugging is removing bugs form a program. Bugs are hard to find like needles

16.2.7 HTML Tags

Question

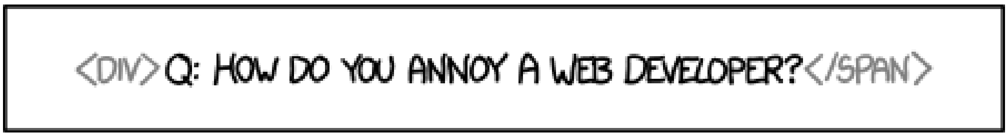


Figure1: `<DIV>Q: How to you annoy a web developer? </SPAN`>`

Answer HTML Tags are wrong DIV and SPAN means the same. Above code is wrong.

16.2.8 Teacher Punishement

Question

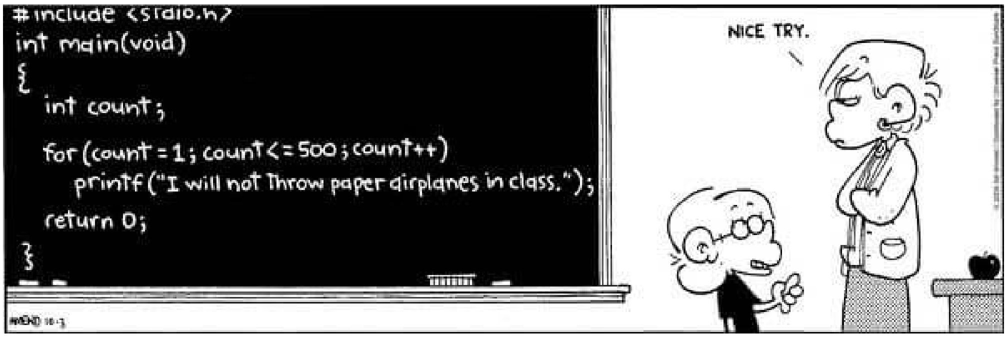

#include <stdio.h>
int main(void)
{
int count;
for (count = 1; count <= 500; count++)
printf("I will not Throw paper airplanes in class.");
return 0;
}
NICE TRY.

Figure2: teacher_punishement

Answer In this joke, his teacher probably gave him the punishment “Write ‘I will not throw paper airplanes in class.’ on the board 500 times.”

```
#include <stdio.h>
int main(void)
{
  int count;
  for (count = 1; count <= 500; count++)
  printf(“I will not throw paper airplanes in class.”);
  return 0;
}
```

16.2.9 Accelerate a computer

Question The best method for accelerating a computer is the one that boosts it by 9.8 m/s2

Answer Let it drop. Earth gravity accelerates it by 9.8m/s2

## SQL Naming **Question**

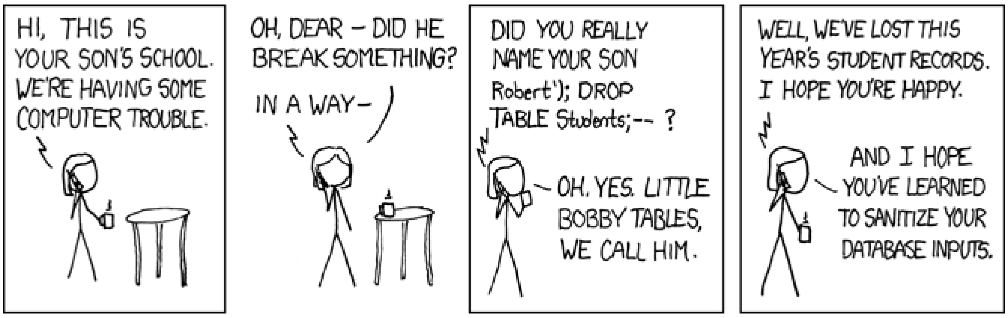

HI, THIS IS YOUR SON'S SCHOOL. WE'RE HAVING SOME COMPUTER TROUBLE.
OH, DEAR – DID HE BREAK SOMETHING?
IN A WAY–
DID YOU REALLY NAME YOUR SON Robert'); DROP TABLE Students;-- ?
OH. YES. LITTLE BOBBY TABLES, WE CALL HIM.
WELL, WE'VE LOST THIS YEAR'S STUDENT RECORDS. I HOPE YOU'RE HAPPY.
AND I HOPE YOU'VE LEARNED TO SANITIZE YOUR DATABASE INPUTS.

Figure3: sql_name

Answer This joke has to do with SQL, which are commands used to control databases as well as a common hack used against insecure sites, called SQL Injection.

16.3 Inspirational Quotes

Computers are useless. They can only give you answers. *Pablo Picasso*
Data is not information, information is not knowledge, knowledge is not understanding, understanding is not wisdom. *Clifford Stoll*
It's hard to fail. But it's worse never to have tried to succeed. *Theodore Roosevelt*
The good news about computers is that they do what you tell them to do. The bad news is that they do what you tell them to do. *Ted Nelson*
Treat your password like your toothbrush. Don't let anybody else use it, and get a new one every six months. *Clifford Stoll*
By three methods we may learn wisdom: First, by reflection, which is noblest; Second, by imitation, which is easiest; and third by experience, which is the bitterest. *Confucius*
A sense of humor is a major defense against minor troubles. *Mignon McLaughlin*
Humor is perhaps a sense of intellectual perspective: an awareness that some things are really important, others not; and that the two kinds are most oddly jumbled in everyday affairs. *Christopher Morley*
Be as smart as you can, but remember that it is always better to be wise than to be smart. *Alan Alda*
Common sense is not so common. *Voltaire*
Every true genius is bound to be naive. *Friedrich Schiller*
If there are no stupid questions, then what kind of questions do stupid people ask? Do they get smart just in time to ask questions? *Scott Adams*
It's not that I'm so smart, it's just that I stay with problems longer. *Albert Einstein*
The true sign of intelligence is not knowledge but imagination. *Albert Einstein*
Insanity: doing the same thing over and over again and expecting different results. *Albert Einstein*
A man should look for what is, and not for what he thinks should be. *Albert Einstein*
Everything that can be counted does not necessarily count; everything that counts cannot necessarily be counted. *Albert Einstein*
The difference between stupidity and genius is that genius has its limits. *Albert Einstein*
A question that sometimes drives me hazy: am I or are the others crazy? *Albert Einstein*
Even if there is only one possible unified theory, it is just a set of rules and equations. What is it that breathes fire into the equations and makes a universe for them to describe? *Stephen Hawking*

Continued on next page

Table 1 – continued from previous page

I have noticed even people who claim everything is predestined, and that we can do nothing to change it, look before they cross the road *Stephen Hawking*
If we do discover a complete theory, it should be in time understandable in broad principle by everyone. Then we shall all, philosophers, scientists, and just ordinary people be able to take part in the discussion of why we and the universe exist *Stephen Hawking*
Intelligence is the ability to adapt to change *Stephen Hawking*
It is no good getting furious if you get stuck. What I do is keep thinking about the problem but work on something else. Sometimes it is years before I see the way forward. In the case of information loss and black holes, it was 29 years *Stephen Hawking*
It is not clear that intelligence has any long-term survival value *Stephen Hawking*
My goal is simple. It is a complete understanding of the universe, why it is as it is and why it exists at all *Stephen Hawking*
One cannot really argue with a mathematical theorem *Stephen Hawking*
Someone told me that each equation I included in the book would halve the sales *Stephen Hawking*
The usual approach of science of constructing a mathematical model cannot answer the questions of why there should be a universe for the model to describe. Why does the universe go to all the bother of existing? *Stephen Hawking*
The whole history of science has been the gradual realization that events do not happen in an arbitrary manner, but that they reflect a certain underlying order, which may or may not be divinely inspired. *Stephen Hawking*
We are just an advanced breed of monkeys on a minor planet of a very average star. But we can understand the Universe. That makes us something very special. *Stephen Hawking*
Rasender Stillstand *Paul Virilio*
Kommunismus der Gefühle *Paul Virilio*
Sarcasm is highly inefficient against stupid people *Unknown*
There are only 10 types of people: Those that understand binary and those that don’t *Unknown*
The day you stop racing is the day you win the race *Bob Marley*
Wenn ich die Menschen gefragt hДtte was sie wollen, hДtten Sie gesagt schnellere Pferde *Henry Ford*
You can’t just ask customers what they want and then try to give that to them. By the time you get it built, they’ll want something new *Steve Jobs*
Don’t get set into one form, adapt it and build your own, and let it grow, be like water. Empty your mind, be formless, shapeless ≈ like water. Now you put water in a cup, it becomes the cup; You put water into a bottle it becomes the bottle; You put it in a teapot it becomes the teapot. Water can flow or it can crash. Be water, my friend *Bruce Lee*

Continued on next page

Table 1 – continued from previous page

Knowing is not enough, we must apply. Willing is not enough, we must do. *Bruce Lee*
Everything in moderation…. including moderation *Keniry Erin*
The glass isn’t half empty, it’s half full, but of poison. *Woody Allen*
I couldn’t help noticing, you noticing me noticing you. *Rango*
Widerstand ist etwas für einzelne, Akzeptanz ist etwas für alle. *Unbekannt*
The optimist claims that we life in the best of all possible worlds, and the pessimists fears that this is true. *Silvan*
Remember less, know more *Silvan*
Everyday is an extention of yesterday *Silvan*
To make the long story short, we thought we had invented bread but we just made them *Guerrino De Luca, Logitech*
Tolle Sache diese Lichtgeschwindigkeit *Unbekannt*
Geocaching, using multibillion dollar technology to find Tupperware hidden in the woods *Unknown*
Lieber haben und nicht brauchen als brachen und nicht haben *Stefan*

16.4 Fonts

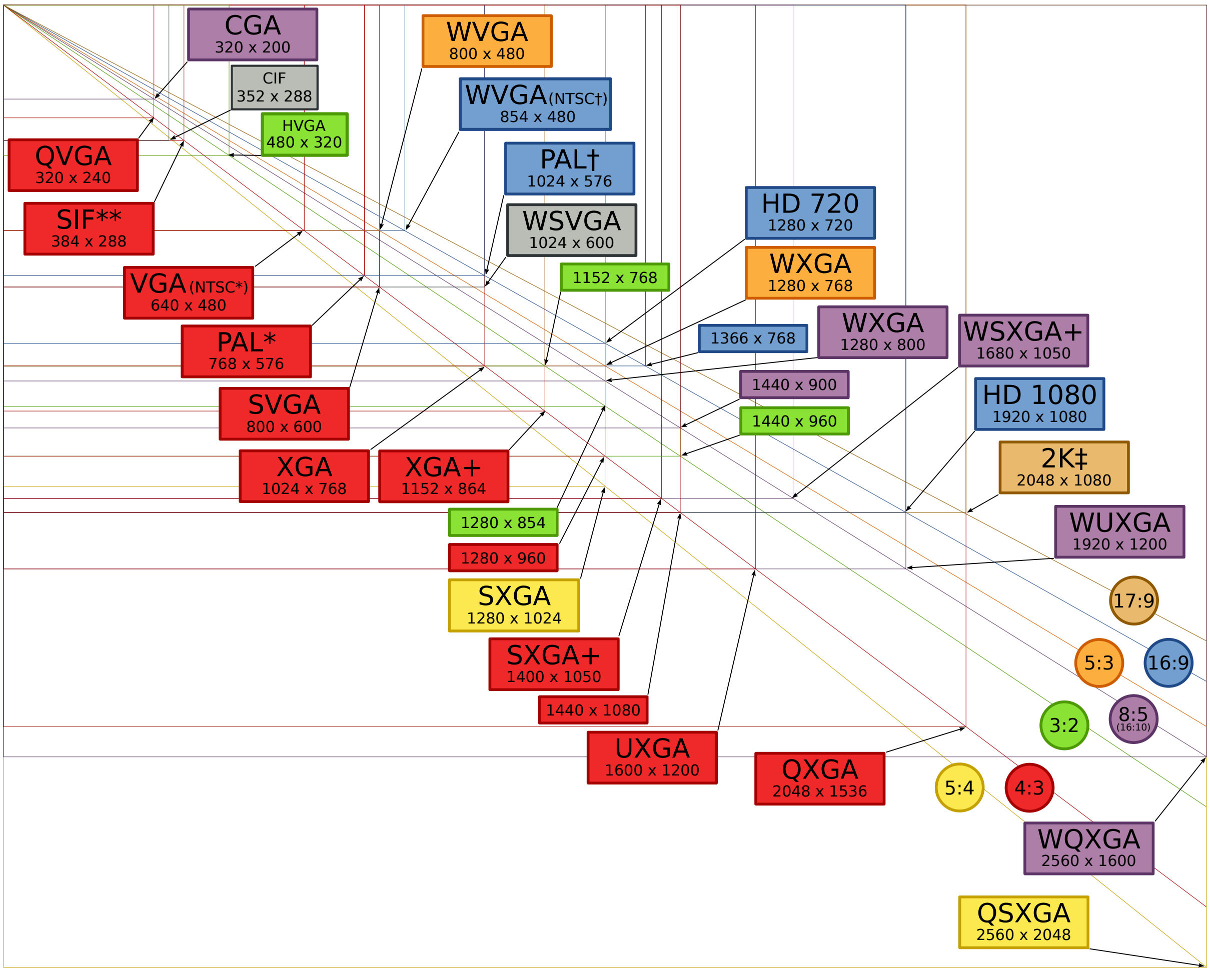
- Lato
- Source Code Pro
- Source Sans Pro
- Source Serif Pro
- Monoid
- NYT Cheltenham
- Fire Code
- Operator Mono

16.5 Icons

16.6 Resolutions

It is important to know the common used display, video and image resolutions.

Acronym	Aspect Ration	Width x Height (px)	Usage
QVGA	4:3	320 x 240	
VGA	4:3	640 x 480	
NTSC	3:2	720 x 480	Television
PAL	4:3	768 x 576	Television
SVGA	4:3	800 x 600	
WSVGA	17:10	1024 x 600	
XGA	4:3	1024 x 768	
XGA+	4:3	1152 x 864	
WXGA	16:9	1280 x 720	HD720
WXGA	5:3	1280 x 768	
WXGA	16:10	1280 x 800	
SXGA-	4:3	1280 x 960	
SXGA	5:4	1280 x 1024	
SXGA+	4:5	1400 x 1050	
HD	~16:9	1360 x 768	
HD	~16:9	1366 x 768	
WXGA+	16:10	1440 x 900	
HD+	16:9	1600 x 900	
UXGA	4:3	1600 x 1200	
WSXGA+	16:10	1680 x 1050	
FHD	16:9	1920 x 1080	HD1080
WUXGA	16:10	1920 x 1200	
2K	17:5	2048 x 1080	
QXGA	4:3	2048 x 1536	
WQHD	16:9	2560 x 1440	
WQXGA	8:5	2560 x 1600	
QFHD	16:9	3840 x 2160	
4K	17:5	4096 x 2160	
18M	3:2	5184 × 3456	Canon 600D


CGA
320 x 200
CIF
352 x 288
HVGA
480 x 320
QVGA
320 x 240
SIF**
384 x 288
WVGA
800 x 480
WVGA (NTSC†)
854 x 480
PAL†
1024 x 576
WSVGA
1024 x 600
VGA (NTSC*)
640 x 480
PAL*
768 x 576
SVGA
800 x 600
XGA
1024 x 768
XGA+
1152 x 864
1152 x 768
HD 720
1280 x 720
WXGA
1280 x 768
1366 x 768
WXGA
1280 x 800
WSXGA+
1680 x 1050
1440 x 900
1440 x 960
HD 1080
1920 x 1080
2K‡
2048 x 1080
WUXGA
1920 x 1200
1280 x 854
1280 x 960
SXGA
1280 x 1024
SXGA+
1400 x 1050
1440 x 1080
UXGA
1600 x 1200
QXGA
2048 x 1536
17:9
5:3
16:9
3:2
8:5
(16:10)
5:4
4:3
WQXGA
2560 x 1600
QSXGA
2560 x 2048

Chapter 17

Security

17.1 GnuPg

17.1.1 Encryption in Linux

To encrypt you need to do the following tasks

1. Install GnuPG
2. Creating a key pair
3. Learn to use public keys
4. Learn Encrypt & Decrypt
5. Learn Sign & Verify

17.1.2 The System

Briefly and without technical detours, the system works as follows. To encrypt and decrypt with GPG, it is necessary to use two different cryptographic keys: a public and a secret key. “Public” keys are used to encrypt and “Private” keys are used to decrypt messages. To send encrypted e.g. e-mails you must have the “public” key of the recipient, which is used to encrypt the message. The recipient then uses his “Private” key to decrypt (and read) the encrypted message. To send encrypted messages to you, senders must first have a copy of your “public” key from your keychain. “Public” keys may be passed on to those who want to send you encrypted messages. For this purpose you can deposit your “Public” Key on a Key Server. “Private” keys may not be passed on.

Note: Key distributionAllocation of keys “Private” keys may not be passed on to anyone, “Public” keys must be distributed to everyone.

17.1.3 Installation of GnuPG

Create of a key pair

```
# Generate of the key pair
gpg --gen-key

# View key informations
gpg --list-keys

# Send key to a keyserver
gpg --send-keys --keyserver wwwkeys.pgp.net <key-id>
```

Import of public key

```
# Get public key from keyserver
gpg --recv-keys --keyserver wwwkeys.pgp.net keyid

# import into the keychain
gpg --import
```

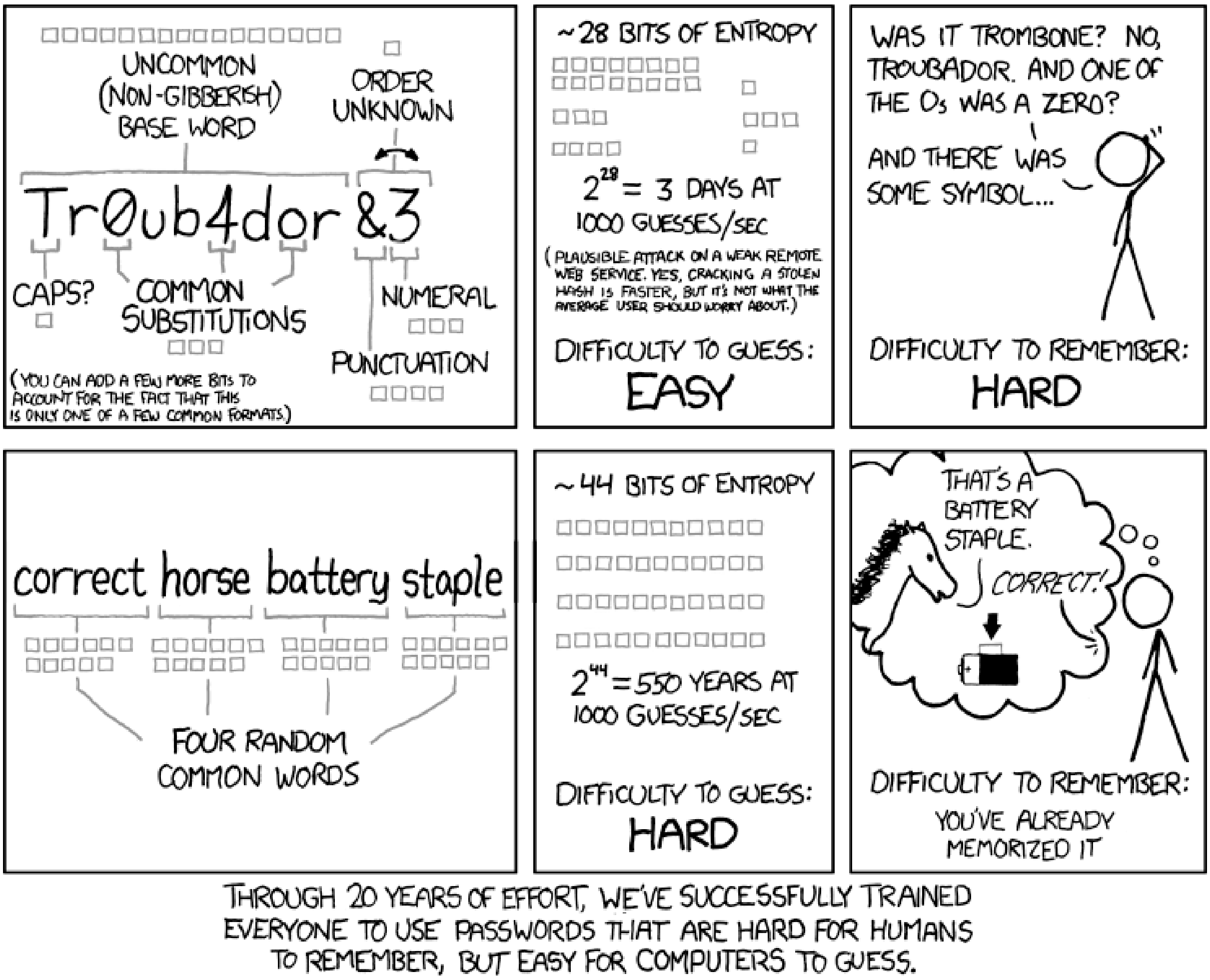
17.1.4 Encryption

```
# Encrypt1
gpg --encrypt filename or gpg -e filename

# Decrypt
gpg --decrypt filename or gpg -d filename

# Sign
gpg --sign filename or gpg -s filename

# Verify
gpg --verify filename or gpg -v filename
```

17.1.5 Links

- Official GnuPG Webpage
- Key Server
- HowTo GnuPG
- Mailvelope enryption for Gmail, Yahoo, GMX, Outlook

17.2 Password


UNCOMMON (NON-GIBBERISH) BASE WORD
ORDER UNKNOWN
Tr0ub4dor&3
CAPS?
COMMON SUBSTITUTIONS
NUMERAL
PUNCTUATION
(YOU CAN ADD A FEW MORE BITS TO ACCOUNT FOR THE FACT THAT THIS IS ONLY ONE OF A FEW COMMON FORMATS.)
~28 BITS OF ENTROPY
2^28 = 3 DAYS AT 1000 GUESSES/SEC
(PLAUSIBLE ATTACK ON A WEAK REMOTE WEB SERVICE. YES, CRACKING A STOLEN HASH IS FASTER, BUT IT'S NOT WHAT THE AVERAGE USER SHOULD WORRY ABOUT.)
DIFFICULTY TO GUESS: EASY
WAS IT TROMBONE? NO, TROUBADOR. AND ONE OF THE Os WAS A ZERO?
AND THERE WAS SOME SYMBOL...
DIFFICULTY TO REMEMBER: HARD
correct horse battery staple
FOUR RANDOM COMMON WORDS
~44 BITS OF ENTROPY
2^44 = 550 YEARS AT 1000 GUESSES/SEC
DIFFICULTY TO GUESS: HARD
THAT'S A BATTERY STAPLE.
CORRECT!
DIFFICULTY TO REMEMBER: YOU'VE ALREADY MEMORIZED IT
THROUGH 20 YEARS OF EFFORT, WE'VE SUCCESSFULLY TRAINED EVERYONE TO USE PASSWORDS THAT ARE HARD FOR HUMANS TO REMEMBER, BUT EASY FOR COMPUTERS TO GUESS.

In order to have a secure password you must do the following take care of

1. Control your passwords
2. Create new secure password and memorize it
3. Change password regularly

17.2.1 Introduction

Who does not know this: you have registered with a new service, or on the server the monthly password change is pending, and you cannot and do not remember a password that meets the requirements of the security concept: either, it is too short, or it is not cryptic enough, or it is too cryptic and you cannot remember it. Finally, because you don't feel like it anymore, you choose any password you like, unfortunately mostly insecure ones.

With this little article I would like to raise security awareness as well as make it easier to choose a secure password by understanding how such a password is constructed. However, I want to say right from the start: assigning secure passwords requires a lot of discipline from the user himself!

Translated with www.DeepL.com/Translator (free version)

17.2.2 Why a secure password is important

Many people think of NOTHING when assigning passwords. But this process is extremely important.

A lot of computer crime could be avoided if more end users would overcome their "inner bastard" and assign reasonable passwords. But to the same extent the shop operators, security officers and others responsible for password acceptance or password suggestions are to blame: I have never seen a web shop with plausibility checks of the password. In addition, general passwords should also be chosen securely for webshops to avoid unauthorized spying of customer passwords.

I am sure that many will say "Who would want to harm me of all people", or "Who would want to read my e-mails of all people". But that is not the point. The attacker does not (usually) care whose account password he gets. He is also not necessarily interested in your e-mails. He is only interested in how he gets into the system. Because once he has access, the war is basically lost. It can order things in your name and send e-mail from your name.

17.2.3 Top 10: Passwords

List of the 10 most frequently used passwords

- Place no. 1: Simple combinations 12345.
- Place no. 2: Number combinations, which remind of a product, such as 4711, 911, X5, A6.
- Place no. 3: The word "Password" itself
- Place no. 4: Pet names like treasure.
- Place no. 5: The word "Baby".
- Place no. 6: Seasons like summer and winter.
- Place no. 7: The word hello.
- Place No. 8: Names of big cities like Zurich, Paris or NewYork.
- Place No. 9: Your own first names.
- Place No. 10: The first name of your wife / girlfriend / husband

17.2.4 Structure of a (relatively) secure password

A secure password consists of upper and lower case letters and numbers. It contains no (perceptible) systematic and is at least 8 characters long. It should not be a word of a known language (e.g. English, German or French).

Security freaks tend to use so-called "keyboard hacks" to generate passwords. This is a one-time, pointless and blind ten-finger hack on the keyboard - you don't remember the password in general, but only the character string as it is entered on the keyboard. Such passwords are of course extremely "secure". Because if you have to enter a password in the presence of other people, for example, you should be able to do so unobtrusively and quickly. In such a situation, anyone who has to rely on the "eagle system" to enter a password will only make it easier for those present to unobtrusively follow the entered character string.

Note: Good passwords should therefore be a middle ground between strings that cannot be guessed and strings that can be remembered. A keyboard hack is a simple and good password.

Password Generator

If you are too uncreative to think up your own "secure" password, you can use the following page to automatically generate easy-to-remember but nevertheless secure passwords of different lengths.

- Keepass
- Safepasswd
- Generista

Password Reuse

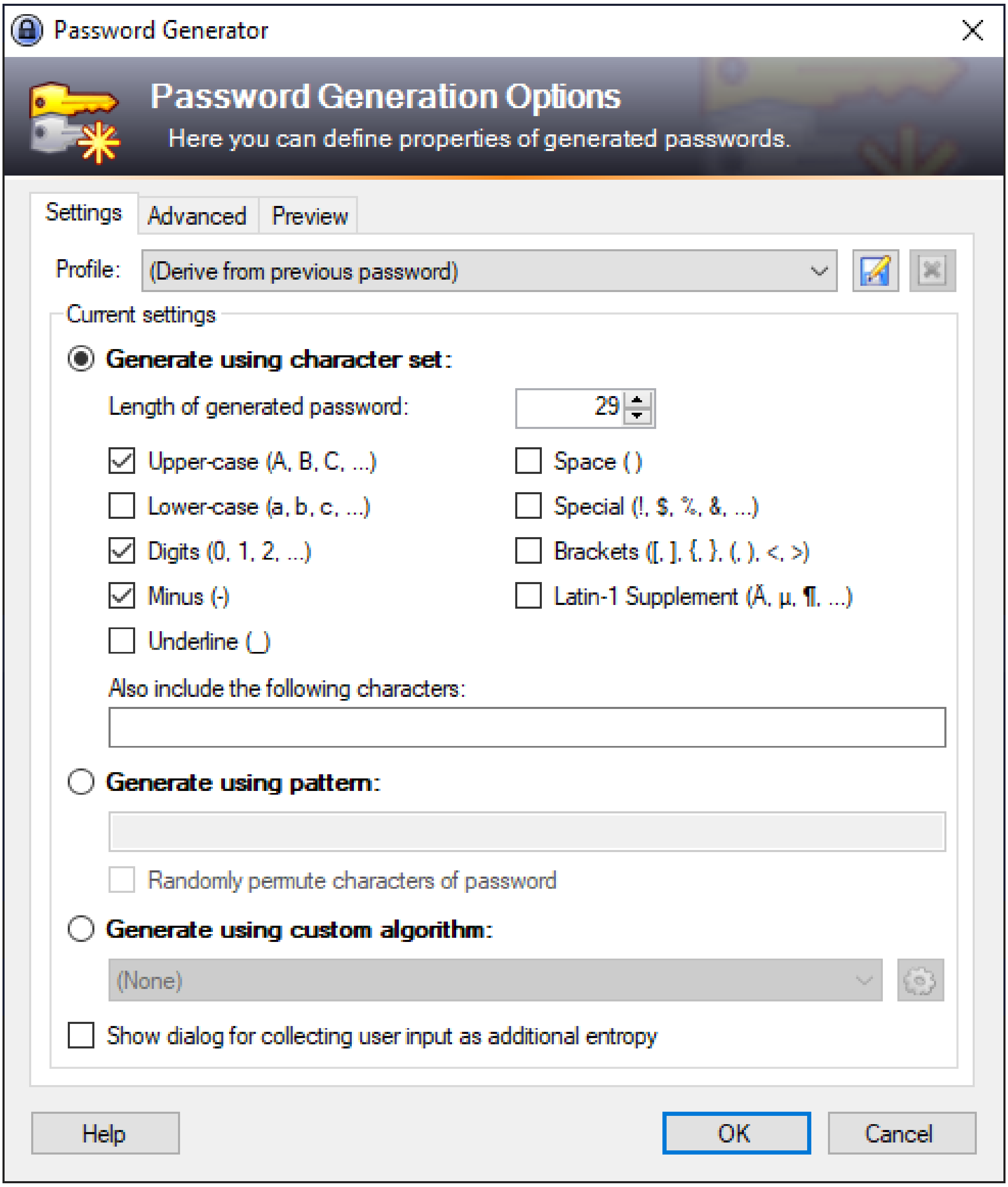
A complete unique password should always be created per platform. Variations can be detected and exploited relatively quickly.

How long should a password be

The question is not so easy to answer. That depends on the security area. Generally speaking, a minimum length of 8 characters is reasonable: 8 characters mean 191707312997281 combinations for character class a-zA-Z1-9 (= 61 characters). At one million keystrokes per second, this would mean a maximum time of about 53252 hours (191707312.997281 seconds) (almost 6 years). That is quite a respectable time :-)

Let's have a small table for an estimation: Minimum length maximum time required (assuming 1 million keystrokes per second)

Number of Symbols	Brute Force Time
3 Symbols	0,2 Seconds
5 Symbols	14 Minutes
8 Symbols	53252 Hours
10 Symbols	1179469 Weeks
12 Symbols	84168853 Year
15 Symbols	19104730610573 Year



Password Generator

Password Generation Options

Here you can define properties of generated passwords.

Profile: (Derive from previous password)

Current settings

● Generate using character set:

Length of generated password: 29

☑ Upper-case (A, B, C, ...)

☐ Lower-case (a, b, c, ...)

☑ Digits (0, 1, 2, ...)

☑ Minus (-)

☐ Underline (_)

☐ Space ( )

☐ Special (!, $, %, &, ...)

☐ Brackets ([,], {, }, (,), <, >)

☐ Latin-1 Supplement (Ä, µ, ¶, ...)

Also include the following characters:

○ Generate using pattern:

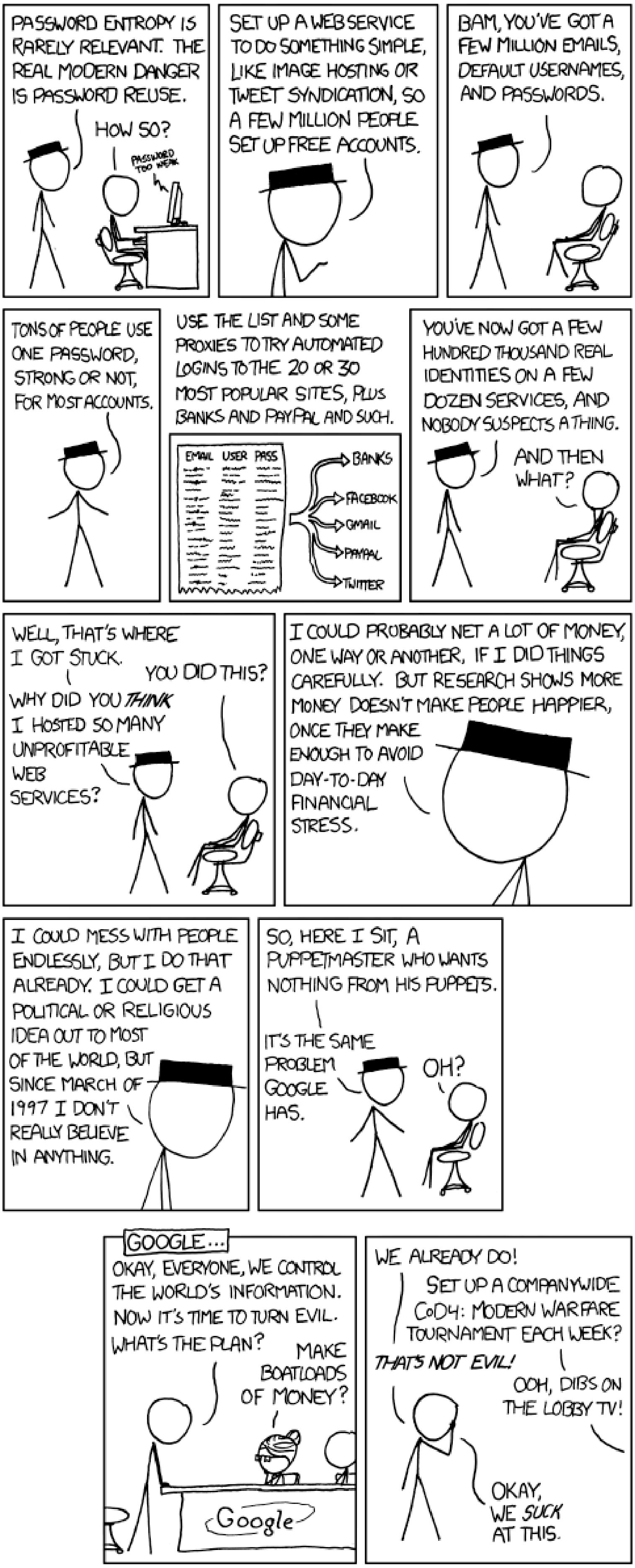
☐ Randomly permute characters of password

○ Generate using custom algorithm:

(None)

☐ Show dialog for collecting user input as additional entropy

Figure1: Keepass Password Generator


PASSWORD ENTROPY IS RARELY RELEVANT. THE REAL MODERN DANGER IS PASSWORD REUSE.
HOW SO?
PASSWORD TOO WEAK
SET UP A WEB SERVICE TO DO SOMETHING SIMPLE, LIKE IMAGE HOSTING OR TWEET SYNDICATION, SO A FEW MILLION PEOPLE SET UP FREE ACCOUNTS.
BAM, YOU'VE GOT A FEW MILLION EMAILS, DEFAULT USERNAMES, AND PASSWORDS.
TONS OF PEOPLE USE ONE PASSWORD, STRONG OR NOT, FOR MOST ACCOUNTS.
USE THE LIST AND SOME PROXIES TO TRY AUTOMATED LOGINS TO THE 20 OR 30 MOST POPULAR SITES, PLUS BANKS AND PAYPAL AND SUCH.
EMAIL USER PASS
BANKS
FACEBOOK
GMAIL
PAYPAL
TWITTER
YOU'VE NOW GOT A FEW HUNDRED THOUSAND REAL IDENTITIES ON A FEW DOZEN SERVICES, AND NOBODY SUSPECTS A THING.
AND THEN WHAT?
WELL, THAT'S WHERE I GOT STUCK.
YOU DID THIS?
WHY DID YOU THINK I HOSTED SO MANY UNPROFITABLE WEB SERVICES?
I COULD PROBABLY NET A LOT OF MONEY, ONE WAY OR ANOTHER, IF I DID THINGS CAREFULLY. BUT RESEARCH SHOWS MORE MONEY DOESN'T MAKE PEOPLE HAPPIER, ONCE THEY MAKE ENOUGH TO AVOID DAY-TO-DAY FINANCIAL STRESS.
I COULD MESS WITH PEOPLE ENDLESSLY, BUT I DO THAT ALREADY. I COULD GET A POLITICAL OR RELIGIOUS IDEA OUT TO MOST OF THE WORLD, BUT SINCE MARCH OF 1997 I DON'T REALLY BELIEVE IN ANYTHING.
SO, HERE I SIT, A PUPPETMASTER WHO WANTS NOTHING FROM HIS PUPPETS.
IT'S THE SAME PROBLEM GOOGLE HAS.
OH?
GOOGLE...
OKAY, EVERYONE, WE CONTROL THE WORLD'S INFORMATION. NOW IT'S TIME TO TURN EVIL. WHAT'S THE PLAN?
MAKE BOATLOADS OF MONEY?
Google
WE ALREADY DO!
SET UP A COMPANYWIDE CoD4: MODERN WARFARE TOURNAMENT EACH WEEK?
THAT'S NOT EVIL!
OOH, DIBS ON THE LOBBY TV!
OKAY, WE SUCK AT THIS.

But now comes the disillusionment. All these are so-called maximum times! Maximum time means: if someone tries to crack the password at the specified speed and only the very last character combination entered is the correct one, then it takes as long as specified. But theoretically, the very first character combination entered could be correct. Then it took only a hundred thousandth of a second to crack the password - despite 15 characters. It is therefore quite possible that an attacker could have found out a password within a few seconds. Just coincidence. Therefore, 8 characters are not a good reason to be on the safe side. In addition, it also depends on the computing power: a million tansten strokes per second were expected. Other, better, later built computers can handle millions of times that. This also pushes more and more into the foreground with the graphics cards brute-force attacks. As an example a new Nividia graphics card with CUDA has 256 processor cores, the clock frequency of such a core can be about 500MHz. This allows the graphics card to test 128E9 = 128000000000 passwords per second.

Of course one should also add that many access systems throw a logging in guest out of the system after so many failed attempts. Then, if he wants to try again, he has to log in with a new identity, in the internet e.g. sometimes also with a different IP address. An attacker can automate such things to a certain extent, however.

Links

- Wikipedia article about password
- Helpful article

17.3 Tor

What is Tor?

Tor (The Onion Router) is free software and an open network that helps you defend against a form of network surveillance that threatens personal freedom and privacy, confidential business activities and relationships, and state security known as traffic analysis.

- Official Tor Webpage
- Check if you’re using Tor

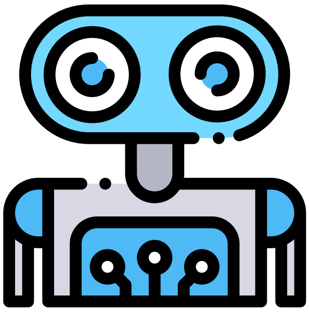
17.3.1 Download

Download the latest **Tor Browser Bundle** from the Tor Webpage

- Tor Bundle Download

Chapter 18

About



18.1 About

18.1.1 Authors

- tschinz - Github Profile

18.1.2 Find me at

- Github
- Flickr
- Twitter @tschinz

18.2 Credits

On this website information, images and documents are used. Hereafter these credits are all listed.

Icons made by Freepik from Flaticon

18.3 How to use Sphinx Documentation

- *Sphinx Requirements*
- *How to create a new Sphinxdoc*
- *How to Build Sphinxdoc locally*
  - *Without pipenv*
  - *With pipenv*
  - *Continuous Build*
- *Commit to Repository*
- *Continuous Integration(CI)*

18.3.1 Sphinx Requirements

- make
  - Windows - GnuWin32
  - Linux

    ```
    sudo apt-get install build-essential
    ```

- Python 3
  - Python
  - Anaconda
- Python Modules (can be installed with pipenv)

  ```
  pip install sphinx
  pip install sphinx-rtd-theme
  pip install sphinxcontrib-wavedrom
  pip install sphinxcontrib-plantuml
  pip install recommonmark
  ```

- Latex Tools (only for latex build)
  - Windows
    - MikTex
    - TexStudio
  - Linux

    ```
    sudo apt install texlive-fonts-recommended texlive-latex-recommended␣
    ↪texlive-latex-extra
    ```

- Inkscape (for `.svg` to `.pdf` and to `.png` conversion)
  - Windows - Inkscape
  - Linux

    ```
    sudo apt-get install inkscape
    ```

18.3.2 How to create a new Sphinxdoc

```
sphinx-quickstart
```

18.3.3 How to Build Sphinxdoc locally

Without pipenv

- Install requirements see: *Sphinx Requirements*
- cd to the git folder
- Generate the desired output

```
make           # list all the available output format
make help      # list all the available output format

make html      # for html
make latex     # for latex
make latexpdf # for latex (will require latexpdf installed)

make clean     # cleans all generated file, TODO before commiting
make clean-images # cleans all autogerated png and pdf files
```

With pipenv

- Install requirements *Sphinx Requirements*
- Create a virtual environment with pipenv (will use the Pipfile for installing the necessary packages)

```
pipenv install
```

- then you can build the documentation

```
pipenv run make html
```

- if you want run `make` multiple times, prepone `pipenv run` on each command can be annoying, you can spawn a subshell with

```
pipenv shell
```

- and then you can use `make` the usual way

```
make           # list all the available output format
make help      # list all the available output format

make html      # for html
make latex     # for latex
make latexpdf # for latex (will require latexpdf installed)

make clean     # cleans all generated file, TODO before commiting
make clean-images # cleans all autogerated png and pdf files
```

all the outputs will be in `_build` folder

- html: `_build/html`
- pdf & tex: `_build/latex`

Continuous Build

During developement or creation of a page, the script `build-loop.bash` will rebuild the webpage every X seconds. In this way a constant preview of the page can be shown.

18.3.4 Commit to Repository

Before performing a commit the following steps are required:

- Verify the `html` documentation local *How to Build Sphinxdoc locally*

  ```
  make html
  ```

- Solve all build `Warnings` and `Errors` display during build in the commandline
- Generate `pdf`

  ```
  make latexpdf
  ```

- Clean the repo from generated files

  ```
  make clean
  ```

- Commit and push the changes *SPL Knowhow CI*

18.3.5 Continuous Integration(CI)

The `.travis.yml` will run on each `master` commit and create a `_build/` folder which will be pushed onto the branch gh-pages and consequently be used by github to displayed static html pages.

18.4 HACK this documentation

- *New Documentation Section*
- *Example Section*
  - *Section Images*
  - *Write the contents*

If you want to add your page to this documentation you need to add your source file in the appropriate section. Every main section has its own folder structure and its own `img/` folder containing all images for this section.

This documentation uses a recursive index tree: every folder have a special `index.rst` file that tell sphinx witch file, and in what order put it in the documentation tree.

If you don't have enough knowledge about ReStructuredText then you can also use the pandoc translator or use the internal *Cheatsheet*

18.4.1 New Documentation Section

If you want to add a new section, you need to specify in the `main index.rst`, the `section/index.rst` file of the new section.

```
.. toctree::
   :hidden:
   :glob:
   :maxdepth: 2
   :titlesonly:
   :caption: Content

   linux/index
   mac/index
   windows/index
   tools/index
   coding/index
   writing/index
   multimedia/index
   security/index
   about/index
```

The section name should be the same as the folder name, but for Sphinx this is not required. Sphinx will take the name of the section from the title of the `section/index.rst` file.

18.4.2 Example Section

I want to document the new topic in SPL Knowhow repo, and want to create a section for it; let's call it `Section`

So I need to create a folder named `section/` (name is not important), and in it create a `section/index.rst` file like:

```
=============
Section Title
=============

.. figure:: img/logo.*
   :align: right
   :width: 150px

.. contents:: :local:

.. toctree::
   :glob:
   :maxdepth: 2
   :titlesonly:
   :caption: Content

   *
```

Note: The `.. toctree::` directive accept some parameters, in this case `:glob:` makes so you can use the `*` to include all the remaining files.

Note: The file path is relative to the index file, if you want to specify the absolute path, you need to prepend `/`

Now I can add additional ReST files like `section/intro.rst` and other files like `section/section_part_1.rst`, `ssection/ection_part_2.rst`, etc.

Section Images

Add an image folder in the section folder `section/img`, in case of additional documents ass a `section/docs` folder too.

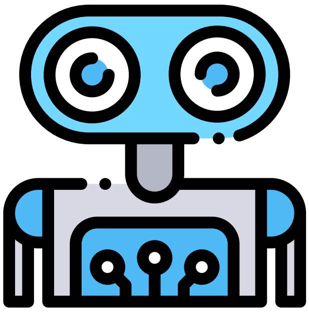
Write the contents

That's it, now you can add all you want in the new section `section` and all pages will show up in the documentation automatically.

18.5 License

Chapter 19

Welcome to Zawiki Knowledge Database



This Repo is a collection of markdown and ReStructuredText pages. Here you can find various informations about topics I've always forget. This pages let me help to remember less but know more.

19.1 Site purpose and structure

19.1.1 Getting started

Want to try it for yourself? Then jump to the *getting started* page and have fun, but first you need to learn *ReStructured Text* !!!

You can view the content as a:

- Webpage
- PDF
- Repo

19.1.2 Known Issues / TODOs

- Github CI not working for PDF creation
- Missing pages from original Zawiki
- missing links to config repo