

Some Mini-Howtos of Interest

Curro Perez-Bernal <francisco.perez@dfaie.uhu.es>

Abstract

A little collection of Mini-Howtos for GNU/Linux systems trying to help solving everyday problems I have found in different aspects, from system administration to basic graphic edition or text processing. The howtos were prepared having Debian systems in mind, but they should be useful for other GNU/Linux systems as well. You can get the latest version of this document from `github` (Mini Howto GEM (<https://github.com/currix/Mini-Howtos-GEM>)). Translations of all or part of this document to French (<http://www.autoteiledirekt.de/science/certains-mini-howtos-dinteret>) (by Kate Bondareva) is also available online.

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Chapter 1

Basic Administration

1.1 Reinstalling a wiped out GRUB

Sometimes, specially if an operating system other than GNU/Linux is installed, the Grub bootloader can be wiped out and the booting process broken. In order to fix this, we will first assume that we have the new version Grub2 installed. Afterwards we explain how to proceed for the older Grub versions.

1.1.1 Grub2 case.

Updated on January 19th, 2012.

The first step is to prepare or find a rescue Live-CD (or bootable Live-USB) so we can start our system. We should know which is the partition of the hard drive that is mounted as root partition in /. We will assume in this example that the HD where the system is installed is /dev/sda and the root partition is sda7. If we do not know this information we can retrieve it using fdisk and mount. Once the Live-CD has booted, we require to open a rescue session in the booting advanced options. We will be prompted for the root partition and we the rescue disk will open a shell with the given root partition mounted.

It is important the if the /var directory is in a partition by itself (e.g. sda8) it is also mounted as follows

```
# mount /dev/sda7 /var
```

We now proceed to run dpkg-reconfigure grub-pc, and Grub2 will be reconfigured and the problem fixed.

In some cases it may be necessary to reinstall Grub in a system running with a live CD. In this case you should first mount the root partition and then install Grub using grub-install

```
sudo grub-install /dev/sda --root-directory=/mnt
sudo reboot
```

In case that the boot menu may not be the same than the previous one, after rebooting you can update it

```
sudo update-grub
```

This last order is the command you need to run when you make changes in the Grub2 configuration. In this version the configuration file is not anymore in the /boot directory but in /etc: /etc/grub.cfg and /etc/grub.d/*.

1.1.2 Old Grub case.

In order to recover the old Grub version we proceed as in the previous case, booting the computer from a Live-CD or Live-USB and opening a terminal. In this terminal we launch Grub

```
$ sudo grub
```

Once in the Grub application we define the root filesystem with the command `root partition`. Remember that root syntax for disk and partitions is `hddisk, partition`, and it starts counting from zero. If, as in the previous case, we assume in this example that the HD where the system is installed is `/dev/sda` and the root partition is `sda7`. Once the root partition is defined we install grub in the disk whose MBR is going to be used (`sda` in this case) and we quit.

```
root (hd0,6)
setup (hd0)
quit
```

We can now reboot the computer normally. In order to recover the previous menu it could be necessary to, after rebooting, execute

```
sudo update-grub
```

1.1.3 References

- 1 <http://sites.google.com/site/easylinuxtipsproject/grub#TOC-The-new-Grub-2-present-in-Ubuntu>
- 2 <http://sites.google.com/site/easylinuxtipsproject/oldgrub>

1.2 Changing the default boot option and hiding the GRUB2 menu Created on January 15th, 2019.

We assume that we have a multiboot computer, controlled with Grub2 and that we want to make Windows :(the default boot option, hiding the initial Grub2 boot menu to avoid perplexing with its options Windoze users. However, we want to make this menu available to those that are interested in work in GNU/Linux. We first proceed changing the default boot option and afterwards we explain how to proceed for hiding the Grub2 menu.

1.2.1 Changing the default boot option for Grub2.

We start checking what are the possible options to boot the system

```
# grep menuentry /boot/grub/grub.cfg
if [ x"${feature_menuentry_id}" = xy ]; then
  menuentry_id_option="--id"
  menuentry_id_option=""
export menuentry_id_option
menuentry 'Ubuntu' --class ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option 'gnulinux-simple-901dd9f7-9195-46ba-9b6c-40aaded49f64' {
  submenu 'Opciones avanzadas para Ubuntu' $menuentry_id_option 'gnulinux-advanced-901dd9f7-9195-46ba-9b6c-40aaded49f64' {
    menuentry 'Ubuntu, con Linux 5.0.0-37-generic' --class ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option 'gnulinux-5.0.0-37-generic (recovery mode)' --class ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option 'gnulinux-5.0.0-37-generic (recovery mode)'
    menuentry 'Ubuntu, con Linux 5.0.0-23-generic' --class ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option 'gnulinux-5.0.0-23-generic (recovery mode)' --class ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option 'gnulinux-5.0.0-23-generic (recovery mode)'
    menuentry 'Ubuntu, con Linux 5.0.0-23-generic (recovery mode)' --class ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option 'gnulinux-5.0.0-23-generic (recovery mode)' --class ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option 'gnulinux-5.0.0-23-generic (recovery mode)'
  }
  menuentry 'Windows Boot Manager (en /dev/nvme0n1p1)' --class windows --class os $menuentry_id_option 'osprober-efi-48AB-20FD' {
    menuentry 'System setup' $menuentry_id_option 'uefi-firmware' {
```

In this case we want to use as a menu entry Windoze, that is the option labelled 'Windows Boot Manager (en /dev/nvme0n1p1)'. You should copy to the clipboard this string (including quotes) and edit the file `/etc/default/grub` where you look for the line `GRUB_DEFAULT=0`

```
# grep DEF grub
GRUB_DEFAULT=0
GRUB_CMDLINE_LINUX_DEFAULT="quiet splash"
```

We change this line to

```
GRUB_DEFAULT='Windows Boot Manager (en /dev/nvme0n1p1)'
```

Notice that you can also use numbers (0 means the first option) but this is more unsafe in case a kernel replacement or upgrade change the number associated to the option. If you want to activate this change before proceeding you run `update-grub`

```
# grep DEF grub
GRUB_DEFAULT='Windows Boot Manager (en /dev/nvme0n1p1)'
GRUB_CMDLINE_LINUX_DEFAULT="quiet splash"
# update-grub
Sourcing file '/etc/default/grub'
Generando un fichero de configuraci3n de grub...
Encontrada imagen de linux: /boot/vmlinuz-5.0.0-37-generic
Encontrada imagen de memoria inicial: /boot/initrd.img-5.0.0-37-generic
Encontrada imagen de linux: /boot/vmlinuz-5.0.0-23-generic
Encontrada imagen de memoria inicial: /boot/initrd.img-5.0.0-23-generic
Encontrado Windows Boot Manager en /dev/nvme0n1p1@EFI/Microsoft/Boot/bootmgfw.efi
AA±adiendo men de entrada de inicio para la configuraci3n del firmware EFI
hecho
```

This last order is the command you need to run when you make changes in the Grub2 configuration.

If you are interested in removing an option from the menu, if it is a kernel versio you can directly uninstall the non used kernels and the corresponding entries will disappear. To remove entries that are not kernel versions, you must change the files located in `/etc/grub.d`.

```
# ls /etc/grub.d/
00_header      10_linux      20_memtest86+  30_uefi-firmware  41_custom
05_debian_theme 20_linux_xen  30_os-prober   40_custom         README
```

If you want to remove all `memtest86+` entries, we could just make the `20_memtest86+` file non-executable, with the command

```
# chmod âx 20_memtest86+
```

And, again, you need to update the grub configuration

1.2.2 Hiding the Grub2 menu

In order to hide the menu shown at boot time by Grub2, giving the option to enter it after a given waiting time the following options should be defined in the file `/etc/default/grub` changing

```
GRUB_TIMEOUT_STYLE=hidden
GRUB_TIMEOUT=10
```

to

```
GRUB_HIDDEN_TIMEOUT_QUIET=false
GRUB_TIMEOUT_STYLE=countdown
GRUB_TIMEOUT=0
```

Grub2 will display a 3 seconds countdown and once finished it will boot to the default option. To stop the countdown and start in another option press `ESC`. Another edit is needed as the OS prober has to be updated to disable the quick-boot feature. This can be done editing the `/etc/grub.d/30_os-prober` and changing the line `quick_boot="1"` to `quick_boot="0"`.

```
# cd /etc/grub.d/
# grep "quick_boot=" 30_os-prober
quick_boot="1"
# vi 30_os-prober
# grep "quick_boot=" 30_os-prober
quick_boot="0"
```

We then make this changes active running `update-grub` and we can reboot the computer normally.

```
# update-grub
Sourcing file '/etc/default/grub'
Generando un fichero de configuraci3n de grub...
Encontrada imagen de linux: /boot/vmlinuz-5.0.0-37-generic
Encontrada imagen de memoria inicial: /boot/initrd.img-5.0.0-37-generic
Encontrada imagen de linux: /boot/vmlinuz-5.0.0-23-generic
Encontrada imagen de memoria inicial: /boot/initrd.img-5.0.0-23-generic
Encontrado Windows Boot Manager en /dev/nvme0n1p1@EFI/Microsoft/Boot/bootmgfw.efi
AA±adiendo men de entrada de inicio para la configuraci3n del firmware EFI
hecho
```

1.2.3 References

- 1 <https://askubuntu.com/questions/879881/how-can-i-get-my-grub-menu-to-be-hidden-and-have-the-rq=1>
- 2 <https://askubuntu.com/questions/879881/how-can-i-get-my-grub-menu-to-be-hidden-and-have-the-rq=1>
- 3 <https://www.howtogeek.com/howto/17787/clean-up-the-new-ubuntu-grub2-boot-menu/>

1.3 Problem with journalizing

There could be a problem with the journalizing if an `ext3` filesystem refuses to be mounted. In the following we suppose that we are mounting an `ext3` filesystem associated to `/dev/sdb2` in mount-point `/media/usb_disk/`.

```
$ mount /media/usb_disk/
mount: wrong fs type, bad option, bad superblock on /dev/sdb2,
missing codepage or other error
In some cases useful info is found in syslog - try
dmesg | tail or so
```

And in the `dmesg` file you will find something like

```
JBD: no valid journal superblock found
EXT3-fs: error loading journal.
```

In order to solve this problem first check if the filesystem can be mounted as `ext2`

```
# mount -t ext2 /dev/sdb2 /mnt/
# ls -la
.  ..  lost+found  misc
```

If, as in the example, it works, unmount it and recreate the journal:

```
# tune2fs -O ^has_journal /dev/sdb2
tune2fs 1.37 (21-Mar-2005)

# tune2fs -j /dev/sdb2
tune2fs 1.37 (21-Mar-2005)
Creating journal inode: done
This filesystem will be automatically checked every 22 mounts or
180 days, whichever comes first. Use tune2fs -c or -i to override.
```

And now you can regularly mount the `ext3` filesystem.

1.4 Labels in `ext2` and `ext3` units

Updated on November 21st, 2016.

The use of labels is a convenient way to handle disk units, specially for *usb* units that can be plugged in and removed. Instead of taking care of the dynamically associated device name the label can unambiguously identify the unit.

The command used to display and change the label name for `ext2` and `ext3` filesystems is `e2label`. The syntax of the command is such that to change or define a label named *newlabel* for unit *device*, the order issued is `e2label device newlabel`. For example

```
# e2label /dev/sdb2 usb_disk
```

To display the label name the command is used with the device name as an argument.

```
# e2label /dev/sdb2
usb_disk
```

To define the corresponding `fstab` entry the following line is added to the file `/etc/fstab`

```
LABEL=usb_disk /media/usb_disk ext3 user,noauto 0 0
```

Note that the last option should be zero for removable media because if this is not the case, the booting process will be affected if the disk is not plugged in. The corresponding mount point should be defined:

```
# mkdir /media/usb_disk
```

Now you can regularly mount the `ext3` filesystem.

```
$ mount /media/usb_disk
```

In the case of `vfat` partitions the equivalent command is `dosfstool`, provided in the Debian package `dosfstools`. For example, to check and change the label of a `vfat` partition:

```
# dosfstool /dev/sdc1
LABEL
# dosfstool /dev/sdc1 DATA_CPB
# dosfstool /dev/sdc1
DATA_CPB
```

1.5 Open a `xconsole` as normal user

First the existence and permissions of the file `/dev/xconsole` has to be checked

```
ls -l /dev/xconsole
prw-r----- 1 root adm 0 2006-05-02 12:40 /dev/xconsole
```

The user who is going to open the `xconsole` in his window manager (e.g. *bob*) has to be added to the `adm` group.

```
adduser bob adm
Adding user 'bob' to group 'adm' ...
Done.
```

The `xconsole` program can be now normally launched

```
xconsole -file /dev/xconsole
```

1.6 Resetting the root password

The first and simplest option is to boot in `single-user` mode. To do so, if the bootloader is `GRUB` stop the booting process and edit the line where the kernel is selected adding 1 at the end of the line. The system should boot to a `root` prompt and the password can be changed using the `passwd` command.

Another possibility is to boot using a rescue disk and once that you are at the command prompt mount the system's root directory if it has not been already mounted. For example, let's assume that the system's root partition is `/dev/sda1` and will be mounted in `/mnt/sysrootdir`

```
mkdir /mnt/sysrootdir
mount /dev/sda1 /mnt/sysrootdir
```

Then, after switching to the system's root directory with `chroot`, reset the password.

```
chroot /mnt/sysrootdir
passwd
```

1.6.1 References

- 1 Tech tip in <http://www.linuxjournal.com/issue/180> (<http://www.linuxjournal.com/issue/180>)

1.7 Configure **exim** to use **SMTP-TLS**

The following instructions explain in a short and direct way the minimal steps necessary to include SMTP-TLS support in **exim** to connect with a *smarthost* node relaying mail. The data provided are appropriate for connecting with the server `mailgw.uhu.es` and for a box with Debian Lenny.

The necessary steps are the following

- 1 Install packages `exim4-base`, `exim4-config`, and `exim4-daemon-light`.

```
[root@localhost ~]# apt-get install exim4-base exim4-config \
exim4-daemon-light
```

- 2 If during the `exim4` installation no question is asked or if the packages are already installed in the computer, reconfigure the mail agent:

```
dpkg-reconfigure exim4-config
```

The following answers apply to configure a box in CLGEM-UHU:

- 1 mail sent by smarthost; received via SMTP or fetchmail
- 2 local mail name *boxname.dfa.uhu.es*
- 3 IP-addresses to listen on for incoming SMTP connections: *127.0.0.1*
- 4 Other destinations for which mail is accepted: *[Blank]*
- 5 Machines to relay mail for: *[Blank]*
- 6 IP address or host name of the outgoing smarthost: *mailgw.uhu.es*
- 7 Hide local mail name in outgoing mail? *Yes*
- 8 Visible domain name for local users: *[Blank]*
- 9 Keep number of DNS-queries minimal (Dial-on-Demand)? *No*
- 10 Delivery method for local mail: *mbox format in /var/mail/*
- 11 Split configuration into small files? *Yes*

- 3 The next step is the generation of the necessary keys.

```
# cd /etc/exim4/
# openssl req -x509 -newkey rsa:1024 -keyout rsa.key -out rsa.cert \
-days 9999 -nodes
# openssl dhparam -out dh.key 1024
```

- 4 Enable TLS in **exim**'s configuration editing the file

`/etc/exim4/conf.d/main/03_exim4-config_tlsoptions`

and adding the following lines

```
tls_certificate = /etc/exim4/rsa.cert
tls_privatekey = /etc/exim4/rsa.key
tls_dhparam = /etc/exim4/dh.key
```

- 5 Edit the user authentication info on file `/etc/exim4/passwd.client`¹. For example, for user `coco.elmo.dfaie` with LDAP password `frdg098r`

```
# password file used when the local exim is authenticating to a remote
# host as a client.
#
# see exim4_passwd_client(5) for more documentation
#
# Example:
### target.mail.server.example:login:password
mailgw.uhu.es:coco.elmo.dfaie:frdg098r
```

- 6 Restart the **exim**'s daemon.

```
# /etc/init.d/exim4 restart
```

¹There should be a way to do this from a user's perspective and not editing a general file for the system (TO DO).

1.7.1 References

- 1 http://www.amk.ca/diary/2003/03/enabling_smtptls_with_exim.html

1.8 Copying CUPS configuration from one server to another

The simplest way to copy the CUPS configuration from one server to another is the following:

- 1 Stop CUPS on the target system.

```
target# /etc/init.d/cups stop
```

- 2 Rename or backup the existing configuration directory

```
target# mv /etc/cups /etc/cups.orig
```

- 3 Copy the /etc/cups directory from the source system to the destination system.

```
target# scp -r source:/etc/cups /etc/cups
```

- 4 Copy any modified model files from the source system to the destination system. These files should be in /usr/share/cups/model.

```
target# scp -r source:/usr/share/cups/model /usr/share/cups/model
```

- 5 On the target server edit the file /etc/cups/cupsd.conf and check if the hostname or IP address of your source system is present. If so, change it to the target server hostname or IP. Check that hostnames are defined properly in the /etc/hosts file of the target system.
- 6 If any custom groups or accounts are used on the old system to manage CUPS recreate them on the new system.
- 7 Restart cups in the target system and test it.

1.8.1 References

- 1 Tech tip in My Scripts and Tips (<http://www.tipsandscripts.net/archives/19>)

1.9 Mapping network interfaces to a fixed name.

As modules on the booting process or during the system's activity are not loaded always in the same order, it is difficult to get the network devices named in a constant way. This can be achieved using the package `ifrename`. This software maps the interfaces to a fixed name based on the MAC address (for example). You just need to add the file /etc/iftab:

```
# Mapping NICs to fixed names
ether0 driver 8139too mac XX:XX:XX:XX:XX:XX
wifi0 driver ipw2200 mac XX:XX:XX:XX:XX:XX
```

Another way to get the same result especially prone to Debian systems is to include an addition of a `udev` rule. In order to do so, create the file /etc/udev/rules.d/net.local.rules, and populate it with the following:

```
KERNEL=="eth*", SYSFS{address}=="00:01:80:50:dc:f2", NAME="wired"
KERNEL=="eth*", SYSFS{address}=="00:0d:61:a1:20:15", NAME="wireless"
```

changing the MAC's addresses and NAME's accordingly.

1.10 Using labels to mount disk partitions

Using the possibility of labelling the disk partitions it is useful for avoiding ambiguities and errors mounting them. This is valid for `ext2`, `ext3`, and `ext4` filesystems. To name `usbdisk0` the second partition of a disk which is currently `/dev/sdb` we should do as follows²

```
# e2label /dev/sdb2 usbdisk0
```

There are other tools to label partitions for different filesystems.

- 1 `ext2 ext3 ext4: e2label`
- 2 `FAT16 FAT32: mtools`
- 3 `jfs: jfstune`
- 4 `NTFS: ntfsprogs`

Then, once the partition is labelled, we create the mount point, e.g. `mkdir /media/usb_disk_0`, and we can add a line in `/etc/fstab` like the following

```
LABEL=usbdisk0          /media/usb_disk_0 ext3      exec,user,noauto 0          0
```

When we use the command `mount /media/usb_disk_0` the previously labelled partition will be mounted.

1.11 Using find and xargs

Updated on January 12th, 2016.

The combination of the utilities `find` and `xargs` is a powerful tool if you need to apply a program or repeat a task with several files.

As an example let's imagine that we have a directory with many LaTeX files, and some of them are letters, named as `lett_name.tex` and we should transform some of them into pdf files. A simple perl oneliner that can do the task of transforming a `tex` file into a `pdf` file is the following.

```
perl -e '(my $name= $ARGV[0])=~s/\.tex//; system "latex $name;dvipdf $name"' file.tex
```

How to select the LaTeX files with different and flexible criteria and apply this program to all of them? A possible answer is to combine the powerful `find` and `xargs` programs.

Let's suppose that we want to transform to pdf format all the files having names starting as `lett_`. Then we can execute

```
$ find . -name "lett_*.tex" -print
./lett_diput_Huelva.tex
./lett_Hospital_IE.tex
./lett_CEPSA.tex
./lett_del_JA_Huelva.tex
./lett_audiencia_Huelva.tex
./lett_subdel_gob_Huelva.tex
./lett_INNOV.tex
./lett_ayto_Huelva.tex
./lett_Hospital_JRJ.tex
./lett_ayto_Palos.tex
```

This command finds all the files starting with `lett_` and finishing as `.tex` and print its names. The option `-iname` makes a case insensitive search. Other interesting options are `-amin n` and `-atime n` where `n` is the number of minutes or hours that have passed since the last time the file was accessed. If the number is negative the effect is the contrary and look for files accessed prior to this time.

The program `xargs` can be combined with `find`. This program in its simplest form takes lines of input and apply programs to them. The simplest use is `xargs -I {} run_command {}`. In this form `xargs` read lines from the standard input and apply to each of them the command `run_command` substituting `{}` by the input line. Instead of the standard input the option `-a filename` permits `xargs` to get its input from a file rather than the standard input. We can combine the two command as follows

²It is also possible to rename the partition using a graphical interface such as `gparted`.


```
$ find . -iname "lett*.tex" -print | xargs -I {} perl -e '(my $name= $ARGV[0])=~s/\.tex//; system "latex $name;dvipdf $name"' {}
```

In multiprocessor computers we can use the interesting option `-P n`, which makes `xargs` to run n number of commands in parallel.

Another interesting option of `find` is `-newer filename`. With this option the program displays the names of the files that are more recent than the file `filename`. Using this in combination with `xargs` we can for example, transfer using `scp` all the files in a directory that are more recent than a given file. If we want to upload to a server called `destination.org` all files in a directory that are more recent than a file called `fulltext.pdf` we should execute

```
$ find ./ -newer fulltext.pdf -print | xargs -I {} scp {} user@destination.org:FilePath
```

Another possible example, let's think that you have several directories and you want to copy files that fulfill some condition to a directory. For example, you want to copy all files having names ending as `_presentation.pdf` to the directory `/media/user/3908-E1A4/`. You can achieve this goal with the following pipe:

```
$ find . -name "*_presentation.pdf" | xargs -I {} cp {} /media/user/3908-E1A4/
```

The following case is a practical example that shows how useful is the combination of pipes in `bash`, making also use of the `xargs` command.

Let's assume that we are copying into a directory a backup of the home folders of several users. Then, by mistake, instead of the directory of a user called `tigu`, we copied the contents of his directory to the backup directory, wreaking some havoc and transforming

```
user1 user2 user3 ... tigu
```

into

```
user1 user2 user3 ... tigu and all tigu files and directories
```

A quick solution, avoiding the selection and deletion by hand of each of the misplaced files and directories, consists in the combination with pipes of several commands

```
$ find . -maxdepth 1 -user tigu | grep -v tigu | xargs rm -r
```

The first command output is a list (non-recursive) of all files and directories in the current directory (assuming that the current directory is where the backup takes place) belonging to user `tigu`.

The first pipe *pipes* the result of this search to the `grep` command, where the directory named `tigu` is explicitly excluded. This is done to prevent the command from erasing the original user home directory.

Finally the output of `grep` is piped to a combination of `xargs` and `rm` that removes the files. For more details in the use of `xargs` see the references below.

Several commands can be launched by `xargs`. For example, let's assume that we want to check the differences between files in two different directories, and we want to know the file it is being tested each time. The way to accomplish this, combining an `echo` statement with the `diff` statement using `xargs` is the following

```
$ ls -l *f90 | xargs -I % sh -c 'echo %; diff % /users/home/laura/prototipo_1.0/fortran/1D/1body/pseudostates/src/%;' | less
```

In this case we are also using a different character as a dummy variable for `xargs` with the option `-I %`.

A last example of several pipes and `xargs` is the following, where we are reconstructing using `rdiff-backup` the accounts of a series of users, excepting user `laura`, from a directory `/home_backup/username` in a node called `backup_server` to the directory `/home` in the node `server`

```
ssh root@backup_server ls -l /home_backup | grep -v laura | xargs -I % sh -c "rdiff-backup -v4 --restore-as-of now root@backup_serv
```

1.11.1 References

- 1 <http://www.linuxjournal.com/article/10643>

1.12 Preparing a USB bootable Linux installation device (Fast way).

Updated on October 6th, 2014.

We need a USB disk that is at least 256 MB in size with a FAT16 partition. Normally the sticks come with a preconfigured single FAT16 partition that is valid. If it is necessary to format the disk you can find instructions in ‘Preparing a USB bootable Debian installation device.’ on the facing page. Take also into account that *all data in the stick will be erased*. Plug in and mount the dist. Let’s assume that the USB disk corresponds to the `/dev/sdb` device.

```
$ mount
/dev/sdb1 on /media/disk type vfat (rw,nosuid,nodev,uhelper=hal,uid=1001,shortname=winnt)
```

Download the Debian image. Take into account that the image should fit into the stick.

```
$ wget -c http://cdimage.debian.org/debian-cd/6.0.1a/i386/iso-cd/debian-6.0.1a-i386-netinst.iso
--2011-05-03 13:37:50-- http://cdimage.debian.org/debian-cd/6.0.1a/i386/iso-cd/debian-6.0.1a-i386-netinst.iso
Resolving cdimage.debian.org... 130.239.18.173, 130.239.18.163, 2001:6b0:e:2018::163, ...
.
.
.
.
Saving to: 'debian-6.0.1a-i386-netinst.iso'

100%[=====>] 198,064,128 1.54M/s in 98s

2011-05-03 13:39:35 (1.92 MB/s) - 'debian-6.0.1a-i386-netinst.iso' saved [198064128/198064128]
```

The CD or DVD image you choose should be written directly to the USB stick, overwriting its current contents with the command `dd if=file of=device bs=4M; sync`. If the pendrive device is `/dev/sdb` and the iso image path is `/media/MSDOS/FSTS/ubuntu-14.04.1-desktop-amd64.iso` the command should be

```
# dd if=/media/MSDOS/FSTS/ubuntu-14.04.1-desktop-amd64.iso of=/dev/sdb bs=4M; sync
245+1 records in
245+1 records out
1028653056 bytes (1.0 GB) copied, 22.5565 s, 45.6 MB/s
```

And the stick is ready.

1.12.1 References

- 1 <http://www.debian.org/releases/stable/i386/ch04s03.html.en>

1.13 Preparing a USB bootable Debian installation device.

The first step is the creation of a FAT16 partition and filesystem in the USB disk. Suppose that the USB disk corresponds to the `/dev/sdb` device. Then, as root we format and include the filesystem.

```
# fdisk /dev/sdb

Disk /dev/sdb: 1 GB, 1997649920 bytes
62 heads, 62 sectors/track, 1015 cylinders
Units = cylinders of 3844 * 512 = 1968128 bytes

   Device Boot      Start         End      Blocks   Id  System
/dev/sdb1    *           1         1015       1950799    6   FAT16

# mkdosfs /dev/sdb1
mkdosfs 3.0.1 (23 Nov 2008)
```

We now proceed to install a bootloader, as `syslinux`, `grub`, or `lilo`. We include `syslinux`³

³Please, note that the packages `syslinux` and `mttools` have to be installed to be able to run `syslinux`.

```
# syslinux /dev/sdb1
#
```

We now add the installer image, mounting the stick and copying the files `vmlinuz` (kernel binary) and `initrd.gz` (initial ramdisk image) to the stick. Both files can be found under the directory `/debian/dists/lenny/main/installer-i386/current/images/hd-media/` of the distribution.

```
# mount /dev/sdb1 /mnt
# ls /mnt
ldlinux.sys
#
# cd /mnt
/mnt# wget http://http.us.debian.org/debian/dists/lenny/main/installer-i386/current/images/hd-media/vmlinuz
--2010-03-12 16:16:23-- http://http.us.debian.org/debian/dists/lenny/main/installer-i386/current/images/hd-media/vmlinuz
Resolving http.us.debian.org... 149.20.20.135, 204.152.191.39, 35.9.37.225, ...
Connecting to http.us.debian.org|149.20.20.135|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 1468976 (1.4M) [text/plain]
Saving to: `vmlinuz'

100%[=====>] 1,468,976 624K/s in 2.3s

2010-03-12 16:16:26 (624 KB/s) - `vmlinuz' saved [1468976/1468976]

deckard:/mnt# wget http://http.us.debian.org/debian/dists/lenny/main/installer-i386/current/images/hd-media/initrd.gz
--2010-03-12 16:16:37-- http://http.us.debian.org/debian/dists/lenny/main/installer-i386/current/images/hd-media/initrd.gz
Resolving http.us.debian.org... 128.30.2.36, 149.20.20.135, 204.152.191.39, ...
Connecting to http.us.debian.org|128.30.2.36|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 5183930 (4.9M) [application/x-gzip]
Saving to: `initrd.gz'

100%[=====>] 5,183,930 1.42M/s in 3.5s

2010-03-12 16:16:40 (1.42 MB/s) - `initrd.gz' saved [5183930/5183930]
```

Now we should create a `syslinux.cfg` configuration file, which at a bare minimum should contain the following two lines:

```
default vmlinuz
append initrd=initrd.gz
```

We finally copy a Debian ISO image (businesscard, netinst or full CD image; be sure to select one that fits) onto the stick and unmount the USB memory stick.

1.13.1 References

- 1 <http://www.debian.org/releases/stable/i386/ch04s03.html.en>

1.14 Upgrading Flashplayer in Debian Lenny using *backports*.

We start adding *Debian Backports*⁴ to `/etc/apt/sources.list`. Be warned: once backports is active the resulting system *can't be considered plain "stable" anymore*.

```
# backports Added by Currix 28/04/10
deb http://www.backports.org/debian lenny-backports main contrib non-free
```

You then proceed to run `apt-get update`. There would probably be an error due to the lack of `backports.org` archive's key.

```
# apt-get update
...

Reading package lists... Done
W: GPG error: http://www.backports.org lenny-backports Release: The following signatures couldn't be verified because the public key
W: You may want to run apt-get update to correct these problems
```

⁴Backports are recompiled packages from testing (mostly) and unstable (in a few cases only, e.g. security updates), so they will run without new libraries (wherever it is possible) on a stable Debian distribution. I recommend you to pick out single backports which fits your needs, and not to use all backports available here (from <http://www.backports.org/dokuwiki/doku.php>).

In order to correct this we can now install the public key from `backports.org`.

```
# apt-get install debian-backports-keyring
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libsilk-1.1-2 libhesiod0 libzephyr3
Use 'apt-get autoremove' to remove them.
The following NEW packages will be installed:
  debian-backports-keyring
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 3362B of archives.
After this operation, 49.2kB of additional disk space will be used.
WARNING: The following packages cannot be authenticated!
  debian-backports-keyring
Install these packages without verification [y/N]? y
Get:1 http://www.backports.org lenny-backports/main debian-backports-keyring 2009.02.20 [3362B]
Fetched 3362B in 0s (29.2kB/s)
Selecting previously deselected package debian-backports-keyring.
(Reading database ... 219559 files and directories currently installed.)
Unpacking debian-backports-keyring (from .../debian-backports-keyring_2009.02.20_all.deb) ...
Setting up debian-backports-keyring (2009.02.20) ...
OK
```

We can now run `apt-get update` without any warning or error. Backport packages are deactivated by default (i.e. the packages are pinned to 1 by using `NotAutomatic: yes` in the Release files, just as in experimental). If you want to install a package from backports run:

```
apt-get -t lenny-backports install package
```

or

```
aptitude -t lenny-backports install package
```

In order to update to Flash Player 10 first you should install the package `flashplugin-nonfree`

```
# apt-get -t lenny-backports install flashplugin-nonfree
.
.
.
2010-04-28 09:46:20 (450 KB/s) - `./install_flash_player_10_linux.tar.gz' saved [4050435/4050435]
#
```

Then update the Flash Player with the command

```
# /usr/sbin/update-flashplugin-nonfree --install
#
```

To check if the plugin has been recognized by `iceweasel` type

```
about:plugins
```

in the browser address line. If there are previous versions of the plugin installed they can interfere. Uninstall them removing from `~/.mozilla/plugins` the corresponding file.

1.14.1 References

- 1 <http://backports.org/dokuwiki/doku.php?id=instructions>
- 2 <http://wiki.debian.org/FlashPlayer>
- 3 <http://plugindoc.mozdev.org/>

1.15 Passive network exploration with p0f.

This utility uses passive techniques to try to guess the what machines exist on a network and properties of these computers. By default the application only listens to packets addressed to the machine executing the application

```
# p0f
p0f - passive os fingerprinting utility, version 2.0.8
(C) M. Zalewski <lcamtuf@edione.cc>, W. Stearns <wstearns@pobox.com>
p0f: listening (SYN) on 'eth0', 262 sigs (14 generic, cksum 0F1F5CA2), rule: 'all'.
```

To look at all the packets, not only the packets addressed to the machine where p0f is running, the interface should be in promiscuous mode, using the `-p` option. Be aware that this can cause a large capture data rate.

Using the `-s` option, the application can work with `tcpdump` data logs. The `-w` option allows to save network traffic data in `tcpdump` format.

Other interesting options are `-M` to activate the masquerade detection algorithm to try to identify hosts behind a NAT, and `-l` to format the output in a one-line style that is easier to `grep`.

1.16 Preparing a bootable flashdisk with Billix.

We start downloading `billix` from its *sourceforge* page. The link can be found in 'References' on the current page. In the present example the downloaded file name is `billix-0.27.tar.gz`. We need a usb flashdisk of a minimum size of 256 MB and with a FAT or FAT32 filesystem. In the present example is the device `/dev/sdb1` mounted in `/media/disk`.

```
$ mount | grep disk
/dev/sdb1 on /media/disk type vfat (rw,nosuid,nodev,uhelper=hal,shortname=winnt,uid=1001)
```

The downloaded file is untarred in the flashdisk

```
$ cd /media/disk
/media/disk$ tar xzf ~/Downloads/billix-0.27.tar.gz
```

The second step is the installation of the MBR (Master Boot Record) in the flashdisk.⁵ This has to be executed as superuser and the syntax is `install-mbr -p1 device` and it is important to select the correct device, as this can wreak havoc if executed in an incorrect device.

```
# install-mbr -p1 /dev/sdb
```

We can now install the bootsector within the first partition running `syslinux -s device/partition`. Again this is a potentially dangerous operation and should never be performed in a wrong partition. Superuser privileges are not necessary to perform this operation.

```
/media/disk$ syslinux -s /dev/sdb1
```

The bootable flash disk is now ready and can be used as nice help for the system administrator. If there is spare space in the flash disk can be used normally for file storing.

1.16.1 References

- 1 Billix project homepage (<http://sourceforge.net/projects/billix/>)

1.17 Recovering a console that is unusable.

Sometimes it is convenient to clean the display of a text console, something that can be done using the shell command `clean`. For more extreme cases, when the console has gone totally berserk, e.g. after displaying binary characters, the initial state can be recovered using the command `reset`. It is possible that you will not be able to see the command while you type, but after its execution the console should return to a saner state.

⁵In Debian systems it is necessary to install the `mbr` package to have access to this tool.

1.18 Simple configuration of `sudo`

A very quick and dirty configuration of `sudo` in order to allow a user, e.g. *tuxie*, to execute programs with superuser privileges can be done adding one line to the `sudoers` file:

```
# echo "tuxie ALL=(ALL) ALL" >> /etc/sudoers
```

A more detailed configuration is required in a sensitive environment.

1.19 Check the groups to which a user belongs.

In order to check to what groups a user, e.g. *tuxie*, belongs the command `groups` can be used:

```
$ groups tuxie
tuxie adm dialout cdrom floppy audio video plugdev
```

1.20 Check the available system `locale` options and establish a default one.

In order to check what `locale` options are compiled and available in a Debian system the user should execute.

```
$ locale -a
C
en_IE
en_IE@euro
en_IE.iso88591
en_IE.iso885915@euro
en_IE.utf8
en_US
en_US.iso88591
es_ES
es_ES@euro
es_ES.iso88591
es_ES.iso885915@euro
es_ES.utf8
POSIX
spanish
```

The system's default locale in Debian systems is found in the `/etc/default/locale` file.

```
$ cat /etc/default/locale
LANG=en_IE.UTF-8
```

The `locale` setting when executing a program can be changed on the fly

```
$ LANG=en_IE.utf8 date
Wed Oct 27 11:54:44 CEST 2010
$ LANG=es_ES.utf8 date
miÃ© oct 27 11:54:52 CEST 2010
$
```

It is recommended to use always a `utf-8` locale as a standard. And to define it only setting the `$LANG` variable, and not a complicate set of `$LC_*` variables. To define the default local for the system use the `dpkg-reconfigure locales` command.

1.21 Change the encoding of given files.

To change the encoding of a file is very useful the application `iconv`. This application transforms a file from a given coding system to the default system encoding or to a different encoding. The different available encoding schemes can be shown with the option `-l` or `--list`

```
$ iconv -l
The following list contain all the coded character sets known. This does
not necessarily mean that all combinations of these names can be used for
the FROM and TO command line parameters. One coded character set can be
listed with several different names (aliases).

437, 500, 500V1, 850, 851, 852, 855, 856, 857, 860, 861, 862, 863, 864, 865,
866, 866NAV, 869, 874, 904, 1026, 1046, 1047, 8859_1, 8859_2, 8859_3, 8859_4,
8859_5, 8859_6, 8859_7, 8859_8, 8859_9, 10646-1:1993, 10646-1:1993/UCS4,

...

ISO-2022-JP-2, ISO-2022-JP-3, ISO-2022-JP, ISO-2022-KR, ISO-8859-1,
ISO-8859-2, ISO-8859-3, ISO-8859-4, ISO-8859-5, ISO-8859-6, ISO-8859-7,
ISO-8859-8, ISO-8859-9, ISO-8859-9E, ISO-8859-10, ISO-8859-11, ISO-8859-13,
ISO-8859-14, ISO-8859-15, ISO-8859-16, ISO-10646, ISO-10646/UCS2,
ISO-10646/UCS4, ISO-10646/UTF-8, ISO-10646/UTF8, ISO-CELTIC, ISO-IR-4,

...

UNICODEBIG, UNICODELITTLE, US-ASCII, US, UTF-7, UTF-8, UTF-16, UTF-16BE,
UTF-16LE, UTF-32, UTF-32BE, UTF-32LE, UTF7, UTF8, UTF16, UTF16BE, UTF16LE,
UTF32, UTF32BE, UTF32LE, VISCII, WCHAR_T, WIN-SAMI-2, WINBALTRIM,
WINDOWS-31J, WINDOWS-874, WINDOWS-936, WINDOWS-1250, WINDOWS-1251,
WINDOWS-1252, WINDOWS-1253, WINDOWS-1254, WINDOWS-1255, WINDOWS-1256,
WINDOWS-1257, WINDOWS-1258, WINSAMI2, WS2, YU
```

For example, if the default encoding is UTF-8 and we want to transform an ISO-8859-1 file named *example* to this encoding we should run

```
$ file non_standard_ISO
non_standard_ISO: ISO-8859 text
$ file non_standard_ISO
non_standard_ISO: ISO-8859 text
curro@deckard:~/temp$ iconv -f ISO-8859-1 non_standard_ISO
Ã±±±±±±±±
Ã;Ã;Ã;Ã;
Ã©Ã©Ã©
ÃÃ
Ã³
Ã°
```

If no output file name is given with the option `-o` the result is displayed in the standard output. Thus, to save the file as `non_standard_UTF` we can execute

```
$ iconv -f ISO-8859-1 non_standard_ISO -o non_standard_UTF
curro@deckard:~/temp$ file non_standard_UTF
non_standard_UTF: UTF-8 Unicode text
```

We can also transform to an encoding that is not the system's default one with the option `-t`

```
$ iconv -f ISO-8859-1 -t UNICODE non_standard_ISO -o non_standard_UNI
$ file non_standard_UNI
non_standard_UNI: Little-endian UTF-16 Unicode character data
```

1.22 Problem with the wireless and nm

Sometimes, specially after having tweaked with the network manually, the NetworkManager applet does not appear any more, or when it appears it informs that it does not manage the wireless networks.

In order to fix this, ensure that the file `/etc/network/interfaces` is like the following, commenting any other thing previously added:

```
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback
```

and make sure to change the option `false` to `true` in the file `/etc/NetworkManager/NetworkManager.conf`

```
[ifupdown]
managed=true
```

With this changes, restarting the network should be all you need to solve the problem.

1.23 Updating Debian

From Wheezy to Jessie. Updated on January 19, 2011.

From Stretch to Buster. Updated on July 18, 2019.

A sensible previous step is to backup some files and directories

```
# tar czf ~/tmp/etc.tgz /etc &
# tar czf ~/tmp/var_lib_dpkg.tgz /var/lib/dpkg/ &
# tar czf ~/tmp/var_lib_apt.tgz /var/lib/apt/ &
# dpkg --get-selections "*" > ~/tmp/selections.txt
# tar czf ~/tmp/var_lib_apptitude_pkgstates.tgz /var/lib/apptitude
```

In order to gain an extra safety margin when upgrading remotely, we suggest that you run upgrade processes in the virtual console provided by `screen`, which enables safe reconnection and ensures the upgrade process is not interrupted even if the remote connection process fails.

```
#
# screen
# screen -ls
There is a screen on:
    10305.pts-0.deck      (22/12/15 14:28:45)      (Attached)
1 Socket in /var/run/screen/S-root.
```

To have a smooth and flawless upgrade, review actions pending in package manager launching `aptitude` and press `g` (Go). If it shows any actions, you should review them and either fix them or implement the suggested actions. If no actions are suggested you will be presented with a message saying No packages are scheduled to be installed, removed, or upgraded. In case you have configured APT pinning it should also be changed to point to packages in the new version. In case you do not know what pinning is do not worry and follow on.

Regardless of the method used for upgrading, it is recommended that you check the status of all packages first, and verify that all packages are in an upgradable state. The following command will show any packages which have a status of Half-Installed or Failed-Config, and those with any error status.

```
# dpkg --audit
The following packages are missing the md5sums control file in the
database, they need to be reinstalled:
p0f                Passive OS fingerprinting tool
libdb4.5           Berkeley v4.5 Database Libraries [runtime]
dhcpc3-common      ISC DHCP common files (transitional package)
```

Reinstall packages with some issues. Transitional packages and other packages in the Obsolete Section often can be removed once reinstalled.

```
#
# aptitude reinstall p0f
The following packages will be REINSTALLED:
p0f
0 packages upgraded, 0 newly installed, 1 reinstalled, 0 to remove and 0 not upgraded.
Need to get 71.0 kB of archives. After unpacking 0 B will be used.
Get: 1 http://ftp.de.debian.org/debian/ wheezy/main p0f i386 2.0.8-2 [71.0 kB]
Fetched 71.0 kB in 0s (122 kB/s)
dpkg: warning: parsing file '/var/lib/dpkg/available' near line 447064 package 'cnews':
 error in Version string 'cr.g7-40.4': version number does not start with digit
dpkg: warning: parsing file '/var/lib/dpkg/available' near line 600967 package 'epic4':
 'Conflicts' field, reference to 'epic4-help': error in version: version number does not start with digit
(Reading database ... 397695 files and directories currently installed.)
Preparing to replace p0f 2.0.8-2 (using .../archives/p0f_2.0.8-2_i386.deb) ...
Unpacking replacement p0f ...
Processing triggers for man-db ...
Setting up p0f (2.0.8-2) ...
#
# aptitude reinstall libdb4.5
The following packages will be REINSTALLED:
libdb4.5
0 packages upgraded, 0 newly installed, 1 reinstalled, 0 to remove and 0 not upgraded.
Need to get 0 B of archives. After unpacking 0 B will be used.
E: I wasn't able to locate a file for the libdb4.5 package. This might mean you need to manually fix this package.
E: I wasn't able to locate a file for the libdb4.5 package. This might mean you need to manually fix this package.
E: Internal error: couldn't generate list of packages to download
```

Check packages on hold


```
# aptitude search "~ahold"
No packages on hold
```

Run `apt-get full-upgrade` which will perform a major version upgrade and may remove some redundant or non-needed packages

```
# apt-get full-upgrade
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
The following packages were automatically installed and are no longer required:
  linux-image-4.9.0-4-amd64 linux-image-4.9.0-5-amd64
  linux-image-4.9.0-6-amd64 linux-image-4.9.0-7-amd64
Use 'apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
```

Run `apt autoremove` to remove automatically installed dependencies no further needed. Notice that we are using the new implementation `apt` instead of `apt-get`. In case this is not working in your system reverts to `apt-get`. To check the differences between the two check references.

```
# apt autoremove
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages will be REMOVED:
  linux-image-4.9.0-4-amd64 linux-image-4.9.0-5-amd64
  linux-image-4.9.0-6-amd64 linux-image-4.9.0-7-amd64
0 upgraded, 0 newly installed, 4 to remove and 0 not upgraded.
After this operation, 765 MB disk space will be freed.
Do you want to continue? [Y/n]
(Reading database ... 433814 files and directories currently installed.)
Removing linux-image-4.9.0-4-amd64 (4.9.65-3+deb9u1) ...
/etc/kernel/postrm.d/initramfs-tools:
update-initramfs: Deleting /boot/initrd.img-4.9.0-4-amd64
/etc/kernel/postrm.d/zz-update-grub:
Generating grub configuration file ...
Found background image: /usr/share/images/desktop-base/desktop-grub.png
Found linux image: /boot/vmlinuz-4.9.0-9-amd64
Found initrd image: /boot/initrd.img-4.9.0-9-amd64
Found linux image: /boot/vmlinuz-4.9.0-8-amd64
Found initrd image: /boot/initrd.img-4.9.0-8-amd64
Found linux image: /boot/vmlinuz-4.9.0-7-amd64
Found initrd image: /boot/initrd.img-4.9.0-7-amd64
Found linux image: /boot/vmlinuz-4.9.0-6-amd64
Found initrd image: /boot/initrd.img-4.9.0-6-amd64
Found linux image: /boot/vmlinuz-4.9.0-5-amd64
Found initrd image: /boot/initrd.img-4.9.0-5-amd64
Found linux image: /boot/vmlinuz-4.9.0-3-amd64
Found initrd image: /boot/initrd.img-4.9.0-3-amd64
.
.
.
Removing linux-image-4.9.0-7-amd64 (4.9.110-3+deb9u2) ...
/etc/kernel/postrm.d/initramfs-tools:
update-initramfs: Deleting /boot/initrd.img-4.9.0-7-amd64
/etc/kernel/postrm.d/zz-update-grub:
Generating grub configuration file ...
Found background image: /usr/share/images/desktop-base/desktop-grub.png
Found linux image: /boot/vmlinuz-4.9.0-9-amd64
Found initrd image: /boot/initrd.img-4.9.0-9-amd64
Found linux image: /boot/vmlinuz-4.9.0-8-amd64
Found initrd image: /boot/initrd.img-4.9.0-8-amd64
Found linux image: /boot/vmlinuz-4.9.0-3-amd64
Found initrd image: /boot/initrd.img-4.9.0-3-amd64
Adding boot menu entry for EFI firmware configuration
done
```

Edit `/etc/apt/sources.list` replacing stretch by buster (previously wheezy by jessie)

```
/etc/apt# cat sources.list
#
# deb cdrom:[Official Debian GNU/Linux Live 9.1.0 xfce 2017-07-23T01:37]/ buster main
#deb cdrom:[Official Debian GNU/Linux Live 9.1.0 xfce 2017-07-23T01:37]/ buster main
deb http://ftp.es.debian.org/debian/ buster main non-free contrib
deb-src http://ftp.es.debian.org/debian/ buster main non-free contrib
deb http://security.debian.org/debian-security buster/updates main contrib non-free
```

```
deb-src http://security.debian.org/debian-security buster/updates main contrib non-free

# buster-updates, previously known as 'volatile'
deb http://ftp.es.debian.org/debian/ buster-updates main contrib non-free
deb-src http://ftp.es.debian.org/debian/ buster-updates main contrib non-free
```

Upgrade packages using the package management tool `apt` (or `apt-get`, see references). In previous releases, `aptitude` was recommended for this purpose, but recent versions of `apt` provide equivalent functionality and also have shown to more consistently give the desired upgrade results. Use `/usr/bin/script` program to record a transcript of the upgrade session. Then if a problem occurs, you will have a log of what happened that could provide exact information in a bug report. To start the recording, type:

```
# script -t 2>~/upgrade-busterstep.time -a ~/upgrade-busterstep.script
Script started, file is /root/upgrade-busterstep.script
#
```

Update package list

```
# apt update
```

Check if you have enough space for the update

```
# apt -o APT::Get::Trivial-Only=true dist-upgrade
....
xserver-xorg-video-fbdev xserver-xorg-video-geode xserver-xorg-video-intel xserver-xorg-video-mach64 xserver-xorg-video-mga
xserver-xorg-video-neomagic xserver-xorg-video-nouveau xserver-xorg-video-openchrome xserver-xorg-video-r128
xserver-xorg-video-radeon xserver-xorg-video-savage xserver-xorg-video-siliconmotion xserver-xorg-video-sisusb
xserver-xorg-video-tdfx xserver-xorg-video-trident xserver-xorg-video-vesa xserver-xorg-video-vmware xsltproc xterm xtrans-dev xvfb
xz-utils yelp yelp-xsl zenity zenity-common zip zlib1g zlib1g-dev
2095 upgraded, 820 newly installed, 54 to remove and 0 not upgraded.
Need to get 3,135 MB of archives.
After this operation, 1,645 MB of additional disk space will be used.
E: You don't have enough free space in /var/cache/apt/archives/.
```

In cases like the present one, when you do not have enough space in `var`, create a temporary `/var/cache/apt/archives` directory

```
# cp -ax /var/cache/apt/archives/ /home/
# ls /home/archives/
lock partial
# mount --bind /home/archives /var/cache/apt/archives
# mount | grep arch
/dev/sda6 on /var/cache/apt/archives type ext3 (rw,relatime,errors=continue,user_xattr,barrier=1,data=ordered)
```

Proceed to a minimal system upgrade to overcome deleting a large number of packages and some possible inconsistencies, and then a full upgrade. To do this run first `apt upgrade` (`apt-get upgrade` in previous versions) followed by `apt fullupgrade` (`apt-get dist-upgrade`). In case the error message indicates so, like in the following example, run `apt-get -f install`

```
# apt upgrade
root@modesto:~# apt upgrade
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
Some packages could not be installed. This may mean that you have
requested an impossible situation or if you are using the unstable
distribution that some required packages have not yet been created
or been moved out of Incoming.
The following information may help to resolve the situation:

The following packages have unmet dependencies:
 inetutils-ping : Conflicts: ping
E: Broken packages
```

This error can be overcome removing the package `inetutils-ping`

```
# apt remove inetutils-ping
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages will be REMOVED:
  inetutils-ping
0 upgraded, 0 newly installed, 1 to remove and 2179 not upgraded.
After this operation, 345 kB disk space will be freed.
Do you want to continue? [Y/n]
(Reading database ... 416910 files and directories currently installed.)
Removing inetutils-ping (2:1.9.4-2+b1) ...
Processing triggers for man-db (2.7.6.1-2) ...
...
```

During the update there was an error, the load spiked up and had to open a console and reattach to the screen session, stop and kill the process, remove the lock files and run `dpkg --configure -a` with the final output.

```
W: Possible missing firmware /lib/firmware/i915/bxt_dmc_ver1_07.bin for module i915
W: Possible missing firmware /lib/firmware/i915/skl_dmc_ver1_27.bin for module i915
W: Possible missing firmware /lib/firmware/i915/kl_dmc_ver1_04.bin for module i915
W: Possible missing firmware /lib/firmware/i915/cnl_dmc_ver1_07.bin for module i915
W: Possible missing firmware /lib/firmware/i915/glk_dmc_ver1_04.bin for module i915
W: Possible missing firmware /lib/firmware/i915/kl_guc_ver9_39.bin for module i915
W: Possible missing firmware /lib/firmware/i915/bxt_guc_ver9_29.bin for module i915
W: Possible missing firmware /lib/firmware/i915/skl_guc_ver9_33.bin for module i915
W: Possible missing firmware /lib/firmware/i915/kl_huc_ver02_00_1810.bin for module i915
W: Possible missing firmware /lib/firmware/i915/bxt_huc_ver01_07_1398.bin for module i915
W: Possible missing firmware /lib/firmware/i915/skl_huc_ver01_07_1398.bin for module i915
Processing triggers for systemd (241-5) ...
Processing triggers for sgml-base (1.29) ...
Errors were encountered while processing:
 man-db
 x11-apps
 yelp
 mate-user-guide
 gnome-user-docs
 gnome-user-guide
#
```

I now retry to apt upgrade

```
# apt upgrade
Reading package lists... Done#####
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
The following packages were automatically installed and are no longer required:
 bdf2psf dmz-cursor-theme docbook-xml calculator gcj-6-jre-lib gfortran-6 g1r1.2-gconf-2.0 g1r1.2-gnomekeyring-1.0 g1r1.2-mate-panel
 isympy-common libbind9-140 libblas-common libcdio-cdda1 libcdio-paranoial libcdio13 libdns162 libexempi3 libfcitx-gclient0 libfcitx
 libgcr-3-common libgfortran-6-dev libgstreamer-plugins-bad1.0-0 libgtksourcview2.0-0 libgtksourcview2.0-common libgutenprint2 lib
 libnm-util12 libntfs-3g871 libpackage-deprecationmanager-perl libpangol.0-0 libpangox-1.0-0 libqrencode3 librarian0 libruby2.3 libsa
 libunbound2 libunique-3.0-0 libxfont1 linux-headers-4.9.0-8-amd64 linux-headers-4.9.0-8-common linux-image-4.9.0-8-amd64 python-ant
 vlc-plugin-video-splitter vlc-plugin-visualization xfce4-mount-plugin
Use 'apt autoremove' to remove them.
The following packages have been kept back:
 anthy auctex biber cups cups-client cups-core-drivers cups-daemon cups-filters cups-filters-core-drivers default-jre default-jre-he
 fcitx-modules g++ gimp gimp-data g1r1.2-evince-3.0 gnome-orca gnome-themes-standard gnustep-base-common gnustep-base-runtime goldel
 hplip-data hplip-gui imagemagick-6.q16 inkscape libapt-pkg-perl libautovivification-perl libcairo-perl libclass-c3-xs-perl libcups2
 libencode-eucjpm5-perl libencode-hanextra-perl libencode-jis2k-perl libevdocument3-4 libevview3-3 libfcgi-perl libfcitx-qt5-1 libff
 libimage-magick-q16-perl libio-socket-ssl-perl liblist-moreutils-perl liblocale-gettext-perl libnet-dbus-perl libnet-ssleay-perl li
 libparams-classify-perl libparams-util-perl libparams-validate-perl libparams-validationcompiler-perl libpoppler-qt5-1 libpython-de
 libpython3-stdlib libqt4-dbus libqt4-designer libqt4-help libqt4-network libqt4-opengl libqt4-qt3support libqt4-script libqt4-sql l
 libqt5gui5 libqt5help5 libqt5network5 libqt5opengl5 libqt5printsupport5 libqt5sql5 libqt5sql5-sqlite libqt5svg5 libqt5test5 libqt5w
 libreoffice-avmedia-backend-gstreamer libreoffice-base libreoffice-base-core libreoffice-base-drivers libreoffice-calc libreoffice-
 libreoffice-help-cs libreoffice-help-da libreoffice-help-de libreoffice-help-dz libreoffice-help-el libreoffice-help-en-gb libreoff
 libreoffice-help-fr libreoffice-help-gl libreoffice-help-hi libreoffice-help-hu libreoffice-help-it libreoffice-help-ja libreoffice
 libreoffice-help-ru libreoffice-help-sk libreoffice-help-sl libreoffice-help-sv libreoffice-help-zh-cn libreoffice-help-zh-tw libre
 libreoffice-l10n-bg libreoffice-l10n-bn libreoffice-l10n-bs libreoffice-l10n-ca libreoffice-l10n-cs libreoffice-l10n-cy libreoffice
 libreoffice-l10n-en-za libreoffice-l10n-eo libreoffice-l10n-es libreoffice-l10n-et libreoffice-l10n-eu libreoffice-l10n-fa libreoff
 libreoffice-l10n-he libreoffice-l10n-hi libreoffice-l10n-hr libreoffice-l10n-hu libreoffice-l10n-id libreoffice-l10n-is libreoffice
 libreoffice-l10n-lt libreoffice-l10n-lv libreoffice-l10n-mk libreoffice-l10n-ml libreoffice-l10n-mr libreoffice-l10n-nb libreoffice
 libreoffice-l10n-pt libreoffice-l10n-pt-br libreoffice-l10n-ro libreoffice-l10n-ru libreoffice-l10n-si libreoffice-l10n-sk libreoff
 libreoffice-l10n-th libreoffice-l10n-tr libreoffice-l10n-ug libreoffice-l10n-uk libreoffice-l10n-vi libreoffice-l10n-xh libreoffice
 libreoffice-report-builder libreoffice-report-builder-bin libreoffice-script-provider-bsh libreoffice-script-provider-js libreoffic
 libreoffice-writer libsane-hpaio libscalar-list-utils-perl libsnmp30 libsort-key-perl libspecio-perl libstdc++6 libsub-identify-per
 libtext-iconv-perl libuim-custom2 libuim-scm0 libuim8 libunicode-collate-perl libunicode-linebreak-perl libvariable-magic-perl libv
 lightdm-gtk-greeter lm-sensors meld mozc-server mozc-utils-gui perl perl-base perl-doc printer-driver-hpcups printer-driver-postscr
 python-matplotlib python-minimal python-numexpr python-numpy python-pandas python-pandas-lib python-pyqt5 python-pyqt5.qtsvg pythor
 python-tables-lib python2.7 python2.7-dev python2.7-minimal python3 python3-brlapi python3-cairo python3-cups python3-dbus python3-
 python3-renderpm python3-reportlab python3-reportlab-accel python3-sip python3-smbc python3-uno qdbus qt5-gtk-platformtheme quodlib
 task-asturian task-asturian-desktop task-basque task-basque-desktop task-belarusian task-belarusian-desktop task-bengali task-benga
 task-brazilian-portuguese-desktop task-british-desktop task-bulgarian task-bulgarian-desktop task-catalan task-catalan-desktop task
 task-croatian-desktop task-cyrillic task-cyrillic-desktop task-czech task-czech-desktop task-danish task-danish-desktop task-deskto
 task-esperanto-desktop task-estonian task-estonian-desktop task-finnish task-finnish-desktop task-french task-french-desktop task-g
 task-greek-desktop task-gujarati task-gujarati-desktop task-hebrew task-hebrew-desktop task-hindi task-hindi-desktop task-hungarian
```

```

task-irish-desktop task-italian task-italian-desktop task-japanese task-japanese-desktop task-kannada-desktop task-kazakh task-kaza
task-kurdish-desktop task-laptop task-latvian task-latvian-desktop task-lithuanian task-lithuanian-desktop task-macedonian task-mac
task-mate-desktop task-nepali-desktop task-northern-sami task-northern-sami-desktop task-norwegian task-norwegian-desktop task-pers
task-punjabi task-punjabi-desktop task-romanian task-romanian-desktop task-russian task-russian-desktop task-serbian task-serbian-c
task-south-african-english-desktop task-spanish task-spanish-desktop task-swedish task-swedish-desktop task-tagalog task-tamil task
task-turkish-desktop task-ukrainian task-ukrainian-desktop task-uyghur-desktop task-vietnamese-desktop task-welsh task-welsh-deskto
texlive-bibtex-extra texlive-extra-utils texlive-font-utils texlive-fonts-extra texlive-fonts-extra-doc texlive-fonts-recommended t
texlive-latex-base texlive-latex-base-doc texlive-latex-extra texlive-latex-extra-doc texlive-latex-recommended texlive-latex-recom
texlive-publishers texlive-publishers-doc texlive-science texlive-science-doc thunar thunar-data uim uim-anthy uim-fep uim-gtk2.0 u
vlc-plugin-qt vlc-plugin-skins2 vlc-plugin-video-output xfce4-sensors-plugin xserver-xorg-core xserver-xorg-video-amdgpu xserver-xo
xserver-xorg-video-qxl xserver-xorg-video-radeon xserver-xorg-video-vesa xserver-xorg-video-vmware
0 upgraded, 0 newly installed, 0 to remove and 518 not upgraded.
6 not fully installed or removed.
After this operation, 0 B of additional disk space will be used.
Do you want to continue? [Y/n]
Setting up man-db (2.8.5-2) ...
Updating database of manual pages ...
man-db.service is a disabled or a static unit, not starting it.
Setting up x11-apps (7.7+7) ...
Setting up yelp (3.31.90-1) ...
Setting up mate-user-guide (1.20.2-1) ...
Setting up gnome-user-docs (3.30.2-1) ...
Setting up gnome-user-guide (3.30.2-1) ...
Processing triggers for menu (2.1.47+b1) ...

```

Success... Now I run `apt full-upgrade` and got a similar problem. The GUI froze and had to switch to the console, and reload the screen. There I removed again the lock files `/var/lib/dpkg/lock` and `/var/lib/dpkg/lock-frontent` and the run `apt --fix-broken install`

```

# apt --fix-broken install
Reading package lists... Done
Building dependency tree
Reading state information... Done
Correcting dependencies... Done
The following packages were automatically installed and are no longer required:
aspell-de-alt bdf2psf debian-zh-faq-s dh-python dmz-cursor-theme doc-debian-fr doc-linux-fr-text doc-linux-pl doc-linux-pl-html docbo
.
.
.
Processing triggers for mime-support (3.62) ...
Processing triggers for man-db (2.8.5-2) ...
Processing triggers for auctex (11.91-2) ...

```

Success... Now run `apt full-upgrade`

```

# apt full-upgrade
Reading package lists... Done
Building dependency tree...
Reading state information... Done
Calculating upgrade... Done
The following packages were automatically installed and are no longer required:
aspell-de-alt bdf2psf debian-zh-faq-s dh-python dmz-cursor-theme doc-debian-fr doc-linux-fr-text doc-linux-pl doc-linux-pl-html doc
fonts-croscore fonts-ebgaramond fonts-ebgaramond-extra fonts-freefont-otf fonts-gfs-artemisla fonts-gfs-complutum fonts-gfs-didot f
fonts-oflb-asana-math fonts-roboto-hinted fonts-roboto-unhinted fonts-sil-gentiumplus fonts-sil-gentiumplus-compact fortune-zh gal
gnome-themes-standard gnome-user-docs gnome-user-guide gvfs-bin iputils-arping isympy isympy-common libaribb24-0 libass5 libavfilter
libboost-date-time1.62.0 libboost-filesystem1.62.0 libboost-iostreams1.62.0 libboost-program-options1.62.0 libboost-system1.62.0 libo
.
.
.
Processing triggers for shared-mime-info (1.10-1) ...
Processing triggers for install-info (6.5.0.dfsg.1-4+b1) ...
Processing triggers for menu (2.1.47+b1) ...
Processing triggers for desktop-file-utils (0.23-4) ...
Processing triggers for libvlc-bin:amd64 (3.0.7-1) ...

```

Repeat `apt full-upgrade` until it results in no errors.

Edit files in folder `/etc/apt/sources.list.d/` like `dropbox.list`, `base.list`, `google-chrome.list`, or `skype-stable.list` in case they exist and change the Debian release version to Buster, e.g.

```

# cat dropbox.list
deb [arch=i386,amd64] http://linux.dropbox.com/debian buster main

```

Rerun `apt update` and `apt upgrade` until no more errors are found. If required run `apt autoremove`

```

# apt update
Hit:1 http://deb.debian.org/debian buster InRelease
Hit:2 http://ftp.es.debian.org/debian buster InRelease

```

```
Hit:3 http://security.debian.org/debian-security buster/updates InRelease
Ign:4 http://dl.google.com/linux/chrome/deb stable InRelease
Hit:5 http://ftp.es.debian.org/debian buster-updates InRelease
Hit:6 http://dl.google.com/linux/chrome/deb stable Release
Hit:7 https://repo.skype.com/deb stable InRelease
Reading package lists... Done
Building dependency tree
Reading state information... Done
All packages are up to date.
```

Once finished with no more errors mount the temporary archives directory and you can use aptitude for package management.

```
# umount /var/cache/apt/archives/
```

And That's all....

1.23.1 References

- 1 Debian Jessie Release Notes (<https://www.debian.org/releases/jessie/amd64/release-notes/ch-upgrading.en.html>)
- 2 apt vs apt-get in Linux Magazine (<http://www.linux-magazine.com/Issues/2018/208/apt-vs.-apt-get>)

1.24 Error in file `/var/lib/dpkg/status`

Added on May 21, 2011.

The arrival of Squeeze has brought the “illegalization” of the underscore as a valid character in the `/var/lib/dpkg/status` file and this cause some havoc if there are some packages having this character in its name

```
warning, in file '/var/lib/dpkg/status' near line 6627 package 'virtualbox':
error in Version string '1.3.6_Debian_etch': invalid character in version number
warning, in file '/var/lib/dpkg/status' near line 6628 package 'virtualbox':
error in Config-Version string '1.3.6_Debian_etch': invalid character in version number
```

The solution is to clean this packages from the list and from the available packages info. In this particular case the package was not installed but still caused the problem.

```
sudo dpkg --clear-avail
sudo aptitude purge virtualbox
```

1.25 How to record terminal sessions using `ttymrec`

Added on September 2nd, 2011.

The recording of terminal sessions can be of utility, specially for teaching purposes. A nice tool to obtain this recordings is the `ttymrec` program.

We will briefly show the way to record your terminal sessions. The first step is to install the `ttymrec` package (in Debian)

```
# apt-get install ttymrec
Reading package lists... Done
Building dependency tree... Done
The following NEW packages will be installed:
  ttymrec
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 30.9kB of archives.
After unpacking 131kB of additional disk space will be used.
Get:1 http://archive.debian.org/etch/main ttymrec 1.0.6-1 [30.9kB]
Fetched 30.9kB in 1s (21.0kB/s)
Selecting previously deselected package ttymrec.
(Reading database ... 103998 files and directories currently installed.)
Unpacking ttymrec (from .../ttymrec_1.0.6-1_i386.deb) ...
Setting up ttymrec (1.0.6-1) ...
#
```

Then a second step is to open a terminal window with a 80x25 size where `tttyrec` will be executed.

Prior to the execution it is useful to create an initialization file to start `tttyrec` with the appropriate settings. This is not mandatory, but can be interesting. A sample file is the following:

```
# input file for starting a bash session using tttyrec
# by Currix TM.
#
# vt100 setting
export TERM=vt100
#
# change prompt
export PS1="$ "
#
# Remove trailing CTRL-C from comments
bind 'set echo-control-characters off'
```

If the name of this file is `.inputrc_tttyrec` the program `tttyrec` should be invoked as

```
tttyrec -e 'bash --rcfile .inputrc_tttyrec'
```

In the references for this chapter ('References' on the following page) a link to a recorded session is found. There it is shown how for example a `vi` session can be included or how comments are made by typing `CTRL-C` at the end of each comment line.

The default output of `tttyrec` is a file named `tttyrecord`. To save the output in a different file the filename should be included at the end of the `tttyrec` program invocation. The output file can be played back using the program `tttyplay`, included in the `tttyrec` package. A sample file can be downloaded and played

```
wget http://www.uhu.es/gem/clinix/descargas/tttyrecord
tttyplay tttyrecord
```

The speed of the playback can be increased with the `+` key or slowed with `-`.

An interesting site to find terminal recordings is `Playterm`, whose URL can be found in the references section.

1.25.1 References

- 1 `tttyrec` homepage (<http://0xcc.net/tttyrec/index.html.en>)
- 2 `tttyrecord` file sample (<http://www.uhu.es/gem/clinix/descargas/tttyrecord>)
- 3 `Playterm` homepage (<http://www.playterm.org/>)

1.26 Using Bash to count the number of files in a directory

Added on September 6th, 2011.

The number of files in a directory, or in general, the number of files displayed by the command `ls` can be counted using a pipe and the command `wc`

```
$ ls -l 1*gif
115810.strip.print.gif
115811.strip.print.gif
115813.strip.print.gif
116637.strip.print.gif
116639.strip.print.gif
116642.strip.print.gif
117321.strip.print.gif
117324.strip.print.gif
118015.strip.print.gif
$ ls -l 1*gif | wc -l
9
```

Some alternatives with `Perl` oneliners can be found in 'Interesting perl oneliners' on page 48

1.27 Getting detailed information about your hardware

Added on November 30th, 2011.

The command `lshw` lists a (very) detailed information about your hardware. The Debian package has the same name. This program should be executed as superuser.

```
deckard
  description: All In One
  product: iMac8,1
  vendor: Apple Inc.
  version: 1.0
.
.
. Very long output here...
.
.
*-network DISABLED
  description: Ethernet interface
  physical id: 1
  logical name: vboxnet0
  serial: 0a:00:27:00:00:00
  capabilities: ethernet physical
  configuration: broadcast=yes multicast=yes
```

To get an abridged output with the essential info the program can be run with the option `-short`.

1.28 Adding your servers load to the screen hardstatus line

Added on December 1st, 2011.

It is possible to configure `screen` to display the cpu load or other information of interest in the `hardstatus` line. In this case we use Perl and `ssh`. We prepare a short Perl script that takes as arguments an argument related to the output format and a server ip. The considered output formats are green (cpu load < 1.0), yellow (3.0 > cpu load >= 1.0), and red (cpu load >= 3.0). The Perl code is called `perl_load`

```
#!/usr/bin/perl
#
use strict;
use warnings;
use 5.010;
#
# by Currix TM
#
my $code = "$ARGV[0]";
my $hostname = "$ARGV[1]";
#
chomp(my $output = `ssh $hostname cat /proc/loadavg`);
my @load = ($1,$2,$3) if ($output =~ /^(\d+\.\d+)\s+(\d+\.\d+)\s+(\d+\.\d+)\s+(\d.*$/);
#
given($code) {
  when ("red") {
    if ($load[0] >= 3.0) {
      $output = $hostname.": ".$load[0];
    } else {
      $output = '';
    }
  }
  when ("orange") {
    if ($load[0] >= 1.0 && $load[0] < 3.0) {
      $output = $hostname.": ".$load[0];
    } else {
      $output = '';
    }
  }
  when ("green") {
    if ($load[0] < 1.0) {
      $output = $hostname.": ".$load[0];
    } else {
      $output = '';
    }
  }
  default {
    $output = "wrong option";
  }
}
print "$output";
```

The script output is the server name and the cpu load average for the past minute if the load is in the interval defined by the format output.

The inclusion of this script in the `.screenrc` is accomplished using backticks. For more information on this point and color formatting check the `screen` man page. An example `.screenrc` is given below

```
shell -$$SHELL
#
backtick 101 31 31 /home/username/bin/perl_load red server_name_or_IP
backtick 102 61 61 /home/username/bin/perl_load orange server_name_or_IP
backtick 103 91 91 /home/username/bin/perl_load green server_name_or_IP
#
hardstatus alwayslastline
hardstatus string '%{= kG}[ %{G}%H %{g}][%= %{=kw}%?%-Lw%?%{r} (%{W}%n*%f%t%? (%u)%?%{r})%{w}%?%+Lw%?%?%= %{g}][ %{B}%Y-%m-%d %{W}%c |'

# Default screens
screen -t mutt 0 mutt
screen -t server 1
screen -t box_1 2 ssh username@rbox_1
screen -t box_2 3 ssh username@box_2
```

1.29 Making a backup of a Gmail account.

Added on December 7th, 2011.

We describe a way of backing up a Gmail mail account making use of IMAP and the `getmail` program. We assume that the copies want to be made in different `mbox` files for different periods of time. For example, a backup copy on a yearly basis.

The first step consist in enabling IMAP access in the settings section of the Gmail account to be backed up and the creation of a set of labels in the Gmail account grouping the messages that will be backed up. This can be accomplished using a search with `before` and `after`. For example, we can search for mail that matches the search `before:2007/10/01 AND after:2007/09/01`, which will include conversations for September 2007, and group the result of the search under the label `mail_sept_2007`.

The second step is the installation of the `getmail4` package, a mail agent program far simpler to configure than `fetchmail`.

```
$ sudo aptitude install getmail4
```

The next step is the more complicated one and implies the configuration of the `getmail` program. In order to do so a `.getmail` directory should be created, with restricted permissions, and a config file `getmail.gmail` edited

```
$ mkdir .getmail
$ chmod og-rx .getmail/
```

This is a sample `getmail.gmail`

```
$ cat getmail/getmail.gmail
[retriever]
type = SimpleIMAPSSLRetriever
server = imap.gmail.com
username = XXXXX@gmail.com
password = XXXXXXXXXXXXX
mailboxes = ("mail_sept_2007",)

[destination]
type = Mboxrd
path = DESTINATION_PATH/mail-sept_2007.mbox

[options]
# print messages about each action (verbose = 2)
# Other options:
# 0 prints only warnings and errors
# 1 prints messages about retrieving and deleting messages only
verbose = 2
message_log = ~/.getmail/getmail.log
```

This file should also have read permissions only for the user owning it. Messages in this example are saved with `Mbox` format. For other alternatives check references. The `Mbox` file has to be created before backing up.

```
$ touch DESTINATION_PATH/mail-sept_2007.mbox
```


The last step is to proceed to download the mail

```
$ getmail -r getmail.gmail
getmail version 4.20.0
Copyright (C) 1998-2009 Charles Cazabon. Licensed under the GNU GPL version 2.
SimpleIMAPSSLRetriever:currix@gmail.com@imap.gmail.com:993:
.
. Lots of output here...
.
1200 messages (596565682 bytes) retrieved, 0 skipped
Summary:
Retrieved 1200 messages (596565682 bytes) from SimpleIMAPSSLRetriever:XXXX@gmail.com@imap.gmail.com:993
```

The resulting Mbox files can be easily accessed with `Mutt` or other mail reader program.

1.29.1 References

- 1 Matt Cutts Blog (<http://www.mattdcutts.com/blog/backup-gmail-in-linux-with-getmail>)
- 2 Peng.u.i.n Blog (http://blog.pengdeng.com/2008/03/backup-gmail-via-imap-using-getmail_16.html)

1.30 Redirecting STDERR to STDOUT

Added on February 3rd, 2012.

Sometimes you need to redirect the standard error output, `STDERR`, merging it with the standard output, `STDOUT`. This is needed, for example, when you have a long error output from a program compilation and you want to pipe it to `less` to peruse the compiler info. This can be done using the standard `bash` redirection tools as `2>&1`. If we want to check the error output of a compilation this can be done as follows

```
$ make all 2>&1 | less
```

Instead, if instead you want to merge `STDOUT` into `STDERR` this is accomplished as `1>&2`.

1.31 Listing and extracting files from a deb package file.

Added on August 11th, 2012.

The `deb` extension marks Debian software package format. This standard is also used in other distributions that are based on Debian (e.g. Ubuntu or Knoppix).

The `dpkg` program is the low level package manager for Debian and with this command you can list and extract the files contained in a package, as shown below.

We use as an example the `ovpc` package. Once we download the file, to display the contents of a debian package the required option is `dpkg -c`

```
$ dpkg -c ovpc_1.06.94-3_i386.deb
dr-xr-xr-x root/root      0 2010-02-25 10:54 ./
dr-xr-xr-x root/root      0 2010-02-25 10:54 ./ovpc/
dr-xr-xr-x root/root      0 2010-02-25 10:54 ./ovpc/pkg/
dr-xr-xr-x root/root      0 2010-02-25 10:54 ./ovpc/pkg/lib/
dr-xr-xr-x root/root      0 2010-02-25 10:48 ./ovpc/pkg/lib/header/
-r-xr-xr-x root/root    130 2009-10-29 17:06 ./ovpc/pkg/lib/header/libov.so
.
.
.
-r-xr-xr-x root/root    131 2009-10-29 17:06 ./ovpc/pkg/etc/conf
dr-xr-xr-x root/root      0 2010-02-25 10:54 ./ovpc/pkg/etc/conf/log.conf
```

You can use `dpkg -x` to extract the files from a deb package as shown below.

```
$ dpkg -x ovpc_1.06.94-3_i386.deb /tmp/ov
$ ls /tmp/ov
ovpc
```

But there is also an alternative way of proceeding. As `deb` files are `ar` archives, containing three files: `debian-binary`, `control.tar.gz`, and `data.tar.gz`. We can use the `ar` and `tar` commands to extract and view the files from the `deb` package.

First, extract the content of the `deb` archive file using `ar`.

```
$ ar -vx ovpc_1.06.94-3_i386.deb
x - debian-binary
x - control.tar.gz
x - data.tar.gz
$
```

Next, extract the content of `data.tar.gz` file as follows.

```
$ tar -xvzf data.tar.gz
./
./ovpc/
./ovpc/pkg/
./ovpc/pkg/lib/
./ovpc/pkg/lib/header/
./ovpc/pkg/lib/header/libov.so
.
.
./ovpc/pkg/etc/conf
./ovpc/pkg/etc/conf/log.con
```

1.31.1 References

- 1 TheGeekStuff (<http://www.thegeekstuff.com/2010/04/view-and-extract-packages/>)

1.32 Using `script` to keep terminal output records.

Added on November 18th, 2012.

The `script` command saves in a file the output of the terminal where it has been executed. The basis command syntax is

```
$ script [filename]
```

If no filename is given then the default filename is `typescript`. Be aware that `script` works best without making use of programs that manipulate the screen such that `vi` or `less`.

To exit `script` you can type `CTRL-D` or `exit`.

You can use the `-a` option to append the output to a file without overwriting it. An example of use of `script` is the following:

```
$ script test_script
Script started, file is test_script
$ who
bara    tty8          2012-11-17 13:57 (:0)
bara    pts/1         2012-11-17 13:58 (:0.0)
$ exit
exit
Script done, file is test_script
$ ls -l test_script
-rw-r--r-- 1 bara rsrchrs 780 Nov 18 12:02 test_script
$ cat test_script
Script started on Sun 18 Nov 2012 12:02:17 PM CET
$ who
bara    tty8          2012-11-17 13:57 (:0)
bara    pts/1         2012-11-17 13:58 (:0.0)
$ exit
exit

Script done on Sun 18 Nov 2012 12:02:33 PM CET
$
```

Another interesting option is to share a session output between two users. This is very handy when explaining to someone a particular feature in the console. In order to do so the `script` output is sent to a `fifo` file and the flush option `-t` is added while the second user should have `ssh` access to the computer where `script` is run.

For example if user `bara` in computer `prague` wants to show her output to user `alice` in computer `wland` and the necessary steps are the following:

On `bara`'s side

```
bara@prague$ mkfifo foo; script -f foo
```

The console now will be temporarily frozen until `alice` starts getting the output from the fifo file `foo`.

```
alice@wland$ ssh alice@prague
alice@prague's password:
WWelcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-33-generic i686)

 * Documentation:  https://help.ubuntu.com/

0 packages can be updated.
0 updates are security updates.

Last login: Sun Nov 18 10:50:37 2012 from platea.local
alice@prague$ cat /home/bara/foo
Script started on Sun 18 Nov 2012 11:21:29 AM CET
bara@prague$
```

And from now on user `bara` can proceed to work on the terminal sharing the output with `alice`. Beware that the permissions in the fifo file and `bara`'s home directory should allow `alice` to access the fifo.

1.33 Checking actual kernel compiling options.

Added on January 8th, 2013.

Sometimes it is necessary to check if the kernel of your computer has been compiled including a particular option. For example, let's check if the kernel has been compiled with the `CONFIG_EFI_PARTITION` option turned on (see 'Using parted to partition memory sticks or formatting HD partitions larger than 2 TB' on this page).

```
$ cd /boot/
$ ls
System.map-2.6.32-5-amd64  config-2.6.32-5-amd64  grub/  initrd.img-2.6.32-5-amd64  vmlinuz-2.6.32-5-amd64
$ grep _EFI_ config-2.6.32-5-amd64
CONFIG_EFI_VARS=m
CONFIG_EFI_PARTITION=y
```

1.34 Using parted to partition memory sticks or formatting HD partitions larger than 2 TB

Added on January 8th, 2013.

Updated on March 22nd, 2019.

Let's start with the larger than 2 TB partitions. The first step is to check whether your kernel has been compiled with the `CONFIG_EFI_PARTITION` option turned on (see 'Checking actual kernel compiling options.' on the current page). If this is so, let's assume that the device assigned to the HD that will be partitioned is `/dev/sdb`, that it is a 2 TB HD and will be mounted in `/large_disk`. The `fdisk` program and its variants cannot be used because the new partition will be too large (larger than 1.5 TB). Be warned that `fdisk` and all its variants will not issue warnings but will create partitions not larger than 1.5 TB.

Be also warned that all the contents of the disk will be lost. *Make the necessary backups in advance.*

Let's assume that you've installed the `parted` program.

```
# parted /dev/sdb
GNU Parted 2.3
Using /dev/sdb
Welcome to GNU Parted! Type 'help' to view a list of commands.
(parted)
```

You can print the actual partition scheme

```
(parted) print
Model: DELL PERC H700 (scsi)
Disk /dev/sdb: 1933GB
Sector size (logical/physical): 512B/512B
```

```
Partition Table: msdos
```

Number	Start	End	Size	Type	File system	Flags
1	1049kB	1933GB	1933GB	primary	ext3	

```
(parted)
```

The next step is to remove the existing partition

```
(parted) rm 1
(parted) print
Model: DELL PERC H700 (scsi)
Disk /dev/sdb: 1933GB
Sector size (logical/physical): 512B/512B
Partition Table: msdos

Number Start End Size Type File system Flags
(parted)
```

Next, the disk is labeled as a gpt disk

```
(parted) mklabel gpt
Warning: The existing disk label on /dev/sdb will be destroyed and all data on this disk will be lost. Do you want to continue?
Yes/No? Yes
(parted) print
Model: DELL PERC H700 (scsi)
Disk /dev/sdb: 1933GB
Sector size (logical/physical): 512B/512B
Partition Table: gpt

Number Start End Size File system Name Flags
(parted)
```

Once the disk is relabeled, the new partition can be created and you can exit parted

```
(parted) mkpart
Partition name? []? primary
File system type? [ext2]?
Start? 0
End? -0
Warning: The resulting partition is not properly aligned for best performance.
Ignore/Cancel? I
(parted) print
Model: DELL PERC H700 (scsi)
Disk /dev/sdb: 1933GB
Sector size (logical/physical): 512B/512B
Partition Table: gpt

Number Start End Size File system Name Flags
1 17.4kB 1933GB 1933GB primary

(parted) quit
Information: You may need to update /etc/fstab.
```

Create the filesystem in the usual way

```
# mkfs.ext4 /dev/sdb1
mke2fs 1.41.12 (17-May-2010)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=0 blocks
117964800 inodes, 471859191 blocks
23592959 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=4294967296
14400 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
    4096000, 7962624, 11239424, 20480000, 23887872, 71663616, 78675968,
    102400000, 214990848
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done

This filesystem will be automatically checked every 37 mounts or
180 days, whichever comes first. Use tune2fs -c or -i to override.
```

Finally check the partition UUID and edit accordingly the `fstab` file.

```
# ls -l /dev/disk/by-uuid/
total 0
lrwxrwxrwx 1 root root 10 Sep 21 11:43 346dc157-f150-4a1e-8b83-bf4a50dc3cad -> ../../sda5
lrwxrwxrwx 1 root root 10 Sep 26 13:00 43615088-9470-419c-9958-199b0bcbbbd6 -> ../../sdb1
lrwxrwxrwx 1 root root 10 Sep 21 11:43 5fa63da1-1ff9-4fbf-93c2-4fcdef686892 -> ../../sda7
lrwxrwxrwx 1 root root 10 Sep 21 11:43 93272bd4-51b2-4e8a-940d-f85d5fa1978d -> ../../sda6
#
```

In our case the previous partition UUID in `fstab` needs to be replaced by the new value `43615088-9470-419c-9958-199b0bcbbbd6` and the filesystem type should be changed also changed if necessary. The corresponding `fstab` line should read as follows

```
# cat /etc/fstab | grep large
# /large_disk was on /dev/sdb1 during installation
UUID=43615088-9470-419c-9958-199b0bcbbbd6 /large_disk ext4 defaults 0 2
```

The final result is

```
# df -h | grep large
/dev/sdb1 1.8T 196M 1.7T 1% /large_disk
```

If necessary, reboot and check that the partition is correctly mounted.

This article was originally written for servers, but after having several times trouble with formatting and creating partitions in memory sticks I decided to update it and address some of the usual problems I face.

1.34.1 Message Warning: The driver descriptor says the physical block size is 2048 bytes, but Linux says it is 512 bytes.

As I learned on the references, this was probably caused by writing an image to the disk using `dd` with the wrong blocksize. This happens to me with a memory stick. Once I umounted the partition and run `parted` I got

```
root@modesto:~# parted /dev/sdc
GNU Parted 3.2
Using /dev/sdc
Welcome to GNU Parted! Type 'help' to view a list of commands.
(parted) print
Warning: The driver descriptor says the physical block size is 2048 bytes, but
Linux says it is 512 bytes.
Ignore/Cancel? C
Model: TOSHIBA TransMemory (scsi)
Disk /dev/sdc: 7759MB
Sector size (logical/physical): 512B/512B
Partition Table: unknown
Disk Flags:
(parted) quit
root@modesto:~#
```

We should wipe out all info in the disk. Be extra careful and do not mix up the device label or you may end erasing all info in the wrong unit... So we check again the units using a command line `parted` with the option `--list`

```
root@modesto:~# parted --list
Model: ATA Micron 1100 SATA (scsi)
Disk /dev/sda: 256GB
Sector size (logical/physical): 512B/4096B
Partition Table: gpt
Disk Flags:

Number  Start      End        Size       File system  Name                Flags
 1      1049kB     630MB     629MB     fat32        EFI system partition  boot, esp
 2      630MB     222GB     221GB     ext4        DEBIAN
 4      222GB     256GB     34.1GB    linux-swap(v1)

Warning: The driver descriptor says the physical block size is 2048 bytes, but
Linux says it is 512 bytes.
Ignore/Cancel? I
Model: TOSHIBA TransMemory (scsi)
Disk /dev/sdb: 31.0GB
Sector size (logical/physical): 2048B/512B
Partition Table: mac
Disk Flags:

Number  Start      End        Size       File system  Name  Flags
 1      2048B     6143B     4096B     Apple       Apple
 2     1925MB    1928MB    2392kB     EFI         EFI
```

So the wrong unit is `/dev/sdb` which truly has a 8GB size. Let's wipe it out.

```
root@modesto:~# wipefs --all /dev/sdb
/dev/sdb: 5 bytes were erased at offset 0x00008001 (iso9660): 43 44 30 30 31
/dev/sdb: 2 bytes were erased at offset 0x000001fe (dos): 55 aa
/dev/sdb: 8 bytes were erased at offset 0x00000200 (gpt): 45 46 49 20 50 41 52 54
/dev/sdb: 2 bytes were erased at offset 0x00000000 (mac): 45 52
/dev/sdb: calling ioctl to re-read partition table: Success
```

And now let's create a new partition and filesystem with parted

```
root@modesto:~# parted /dev/sdb
GNU Parted 3.2
Using /dev/sdb
Welcome to GNU Parted! Type 'help' to view a list of commands.
(parted) print
Error: /dev/sdb: unrecognised disk label
Model: TOSHIBA TransMemory (scsi)
Disk /dev/sdb: 7759MB
Sector size (logical/physical): 512B/512B
Partition Table: unknown
Disk Flags:
(parted) mklabel gpt
(parted) mkpart
Partition name? []? data
File system type? [ext2]? fat32
Start? 0
End? -1
Warning: The resulting partition is not properly aligned for best performance.
Ignore/Cancel? I
(parted) print
Model: TOSHIBA TransMemory (scsi)
Disk /dev/sdb: 7759MB
Sector size (logical/physical): 512B/512B
Partition Table: gpt
Disk Flags:

Number  Start   End     Size    File system  Name  Flags
  1      17.4kB  7758MB  7758MB  fat32        data

(parted) quit
Information: You may need to update /etc/fstab.

root@modesto:~# mkfs.vfat /dev/sdb1
mkfs.fat 4.1 (2017-01-24)
root@modesto:~#
```

TODO Get rid of The resulting partition is not properly aligned for best performance warning.

1.34.2 References

- 1 Cyberciti (<http://www.cyberciti.biz/tips/fdisk-unable-to-create-partition-greater-2tb.html>)
- 2 USB Stick corrupted (<https://bugs.launchpad.net/ubuntu/+source/usb-creator/+bug/1708881>)

1.35 Adding a partition to `fstab` by UUID

Added on January 31st, 2015.

Assume that you have reformatted your hard disk and created a new partition, maybe liberating some space from other operating system, and you want to add the new partition to your GNU/Linux system. In our case we suppose that the new partition is `/dev/sda9` with an `ext4` filesystem and we want to mount it in a `/data` directory. We then want to give access to a system's user, for instance, user `curro` to this partition.

The first step is check the partition UUID,

```
$ ls -l /dev/disk/by-uuid/
total 0
lrwxrwxrwx 1 root root 10 Feb 1 20:17 2AF23ED0F23E9FCD -> ../../sda1
lrwxrwxrwx 1 root root 10 Jan 31 20:43 2e6850cc-0bb9-4f36-b0a8-cl67aa257dd6 -> ../../sda7
lrwxrwxrwx 1 root root 10 Jan 31 20:43 55d1fe60-aed5-43c2-9c57-34cdea5accda -> ../../sda6
lrwxrwxrwx 1 root root 10 Jan 31 20:43 578091f7-b057-481a-82b3-6db5a3b86bec -> ../../sda5
lrwxrwxrwx 1 root root 10 Feb 1 20:17 5c1dccb0-e78a-48cc-a63d-95148a8f6cb5 -> ../../sda9
lrwxrwxrwx 1 root root 10 Feb 1 20:16 5F1F-1069 -> ../../sdc1
lrwxrwxrwx 1 root root 10 Feb 1 20:17 6E223D37223D059D -> ../../sda3
lrwxrwxrwx 1 root root 10 Feb 1 20:16 9dbd2628-0353-4798-85e4-738b25d0cdd5 -> ../../sdc2
lrwxrwxrwx 1 root root 10 Feb 1 20:17 c30b003f-11f6-430d-8c19-892d68b2c0cf -> ../../sda8
lrwxrwxrwx 1 root root 10 Feb 1 20:17 EC7A41587A412126 -> ../../sda2
```

We then, as root, create the mount point, `/data` and add the following line to the `/etc/fstab`

```
UUID=5c1dccb0-e78a-48cc-a63d-95148a8f6cb5    /data    ext4    defaults,user_xattr    0    2
```

Once the `fstab` file is saved, we can now mount the new partition

```
# mount /data
# mount | grep sda9
/dev/sda9 on /data type ext4 (rw,relatime,data=ordered)
```

The last step is to give user *curro* access to this directory. This is done creating a directory and assigning the directory to this user

```
# mkdir downloads_curro
root@kimoshi:/data# chown curro:curro downloads_curro/
```

Then user *curro* can move the data in his folder `Downloads` to this new directory and link the old folder to the new one.

```
$ mv Downloads/* /data/downloads_curro
$ rmdir Downloads
$ ln -fs /data/downloads_curro ./Downloads
```

1.36 Error ejecting a CD

Added on January 31st, 2015.

Sometimes when you eject a CD from the terminal the system displays the following error

```
$ eject
eject: unable to eject, last error: Inappropriate ioctl for device
```

The same error is obtained when we try to eject the CD as superuser

```
# eject
eject: unable to eject, last error: Inappropriate ioctl for device
```

The verbose output is

```
# eject -v /dev/sr0
eject: device name is '/dev/sr0'
eject: expanded name is '/dev/sr0'
eject: '/dev/sr0' is not mounted
eject: '/dev/sr0' is not a mount point
eject: '/dev/sr0' is not a multipartition device
eject: trying to eject '/dev/sr0' using CD-ROM eject command
eject: CD-ROM eject command failed
eject: trying to eject '/dev/sr0' using SCSI commands
eject: SCSI eject failed
eject: trying to eject '/dev/sr0' using floppy eject command
eject: floppy eject command failed
eject: trying to eject '/dev/sr0' using tape offline command
eject: tape offline command failed
eject: unable to eject, last error: Inappropriate ioctl for device
```

The solution is, as root, use the `-i off` option and then eject the cd

```
deckard:~# eject -i off /dev/cdrom
CD-Drive may be ejected with device button
deckard:~# eject /dev/cdrom
```

An the CD is cleanly ejected. Happy end.

1.37 Killing an unresponsive X-windows

Added on April 2nd, 2016.

Assuming that we have a terminal or any XWindows application that is unresponsive and we do not know its associated PID we can kill it in the following way.

We first open a terminal and start the `xwininfo` program. It will ask us to select the window we are interested in, and once we click on it we will get info like the following:

```
$ xwininfo
xwininfo: Please select the window about which you
          would like information by clicking the
          mouse in that window.

xwininfo: Window id: 0x5c0006a "Printer Properties - 'HP-LaserJet-CP-1025nw' on localhost"

Absolute upper-left X: 1422
Absolute upper-left Y: 649
Relative upper-left X: 1
Relative upper-left Y: 28
Width: 537
Height: 336
Depth: 32
Visual: 0x7b
Visual Class: TrueColor
Border width: 0
Class: InputOutput
Colormap: 0x5c00049 (not installed)
Bit Gravity State: NorthWestGravity
Window Gravity State: NorthWestGravity
Backing Store State: NotUseful
Save Under State: no
Map State: IsViewable
Override Redirect State: no
Corners: +1422+649 -1327+649 -1327-95 +1422-95
-geometry 537x336+1421-94
```

The important piece of data is the window id, in this case `0x5c0006a`. We can now kill the window using the program `xkill`

```
$ xkill -id 0x5c0006a
xkill: killing creator of resource 0x5c0006a
```

And the window is killed. RIP.

1.38 Enlarging the size of a tmp directory

Added on November 14th, 2016.

The situation is that we assume that your `tmp` directory is mounted in a partition and, as usually happens with good old servers, it gets full for a particular task. In this particular case it was cleaning a huge `Inbox` file. The first step is to reserve space for you new `tmp` directory in a filesystem where you have enough space. We reserve 3Gb in a file called `tmp-dir` in a directory called `/vserver`

```
# dd if=/dev/zero of=/vserver/tmp-dir bs=1024M count=3
3+0 records in
3+0 records out
3221225472 bytes (3.2 GB) copied, 62.3108 s, 51.7 MB/s
# ls -l /vserver/tmp-dir
-rw-r--r-- 1 root root 3221225472 Nov 14 12:28 /vserver/tmp-dir
```

We then proceed to create a filesystem into the created filespace. You may be warned that the file is not a block device.

```
# mke2fs -j /vserver/tmp-dir
mke2fs 1.41.12 (17-May-2010)
/vserver/tmp-dir is not a block special device.
Proceed anyway? (y,n) y
warning: Unable to get device geometry for /vserver/tmp-dir
Filesystem label=
```



```

OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=0 blocks
196608 inodes, 786432 blocks
39321 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=805306368
24 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376, 294912

Writing inode tables: done
Creating journal (16384 blocks): done
Writing superblocks and filesystem accounting information: done

This filesystem will be automatically checked every 33 mounts or
180 days, whichever comes first.  Use tune2fs -c or -i to override.

```

In order to copy the contents of the actual `tmp` directory and set the right permissions we mount the just created filesystem in a mount point, e.g. `mnt` and proceed

```

# mount -t ext3 -o loop /vserver/tmp-dir /mnt
# mount | grep mnt
/dev/loop0 on /mnt type ext3 (rw)
# cp -a /tmp/* /mnt/
# chmod 1777 /mnt
# umount /mnt

```

Next, we mount the created filesystem as the system's `tmp` directory

```

# mount -t ext3 -o loop /vserver/tmp-dir /tmp
# df -h | grep /tmp
/dev/sda7          3.0G   69M   2.8G   3% /tmp
/dev/loop0         3.0G   69M   2.8G   3% /tmp

```

Note that the file has been mounted on the same point as the old `tmp`, the block device `/dev/sda7`, but the size is the new size, 3GB. Once we carry out the tasks we needed the enlarged `tmp` directory for, we can unmount and recover the initial state of the syste.

```

# umount /dev/loop0
# df -h | grep /tmp
/dev/sda7          1.9G   35M   1.8G   2% /tmp

```

And that's all.

1.38.1 References

- 1 YourHowto.Net (<http://www.yourhowto.net/increase-tmp-partition-size-linux/>)

1.39 Checking if a package is installed in Debian

Added on March 18th, 2018.

We want to check for example whether a package is installed or not in a Debian system. For example, let's check if the package `acl` is installed. There are different ways of doing this.

One option implies `dpkg`

```

$ dpkg -l acl
Desired=Unknown/Install/Remove/Purge/Hold
| Status=Not/Inst/Conf-files/Unpacked/halF-conf/Half-inst/trig-aWait/Trig-pend
|/ Err?=(none)/Reinst-required (Status,Err: uppercase=bad)
||/ Name          Version          Architecture    Description
+++-+-----+-----+-----+-----+
ii  acl              2.2.52-3+b1      amd64           Access control list utilities

```

The important piece of data are the two `ii` at the beginning of the line, showing that the package is installed. In case that the package were not installed, the line begins with `u` or `p` or the output would be as follows

```
$ dpkg -l 2ping
dpkg-query: no packages found matching 2ping
```

Another option uses the `apt-cache policy` application

```
$ apt-cache policy acl
acl:
  Installed: 2.2.52-3+b1
  Candidate: 2.2.52-3+b1
  Version table:
*** 2.2.52-3+b1 500
    500 http://ftp.es.debian.org/debian stretch/main amd64 Packages
    500 http://deb.debian.org/debian stretch/main amd64 Packages
    100 /var/lib/dpkg/status
```

and

```
$ apt-cache policy 2ping
2ping:
  Installed: (none)
  Candidate: 3.2.1-1
  Version table:
    3.2.1-1 500
    500 http://ftp.es.debian.org/debian stretch/main amd64 Packages
    500 http://deb.debian.org/debian stretch/main amd64 Packages
```

Chapter 2

Network and Navigators

2.1 Running multiple **firefox** instances

In order to execute **firefox** (**mozilla** or **iceweasel**) from a machine that is different to the local box while running **firefox** locally the program should be launched as:

```
firefox -no-remote
```

2.2 Electronic signature with **iceweasel**

In order to sign documents of the *Junta de Andalucía* or *Universidad de Huelva* with **firefox** (**mozilla** or **iceweasel**) the following steps should be accomplished. This has been tested with the electronic administration website of the UHU (www.uhu.es/ae)

First a certificate from the FNMT accrediting the identity of the person who is going to sign the document should be among the certificates available to the navigator. If it is not so, it should be imported (Preferences -> Advanced -> Encryption -> View Certificates -> Import).

Once this is done the package¹ **sun-java6-plugin** should be installed and the navigator should be restarted after its installation.

The files **jss33.jar** (<https://ws022.juntadeandalucia.es/firmadigital/servicio/paginas/jss33.jar>) and **libjss3.so** (<https://ws022.juntadeandalucia.es/firmadigital/servicio/paginas/libjss3.so>) have to be downloaded. A page is opened with the instructions when the navigator detects its absence. They have to be copied with the appropriate permissions to the right plugin directory

```
# chmod 644 jss33.jar
# cp jss33.jar /usr/lib/jvm/java-6-sun/jre/lib/ext/
# chmod 755 libjss3.so
# cp libjss3.so /usr/lib/jvm/java-6-sun/jre/lib/i386/client/
```

Once this is done the electronic administration page should allow us to fill the form and (hopefully) to sign it.

2.3 Some tips to access the web using the console

The original console web browser is **lynx**. In order to avoid questions inquiring whether you accept or not cookies it can be invoked using the option

```
$ lynx -accept_all_cookies
```

¹Written for Debian Lenny.

Another interesting option is `-dump`. When using this option the program writes the lynx output and writes it to the standard output. More modern and flexible is the `links` browser, that can be used in text mode but also can be compiled to be accessed from a graphical display (option `-g`). The `-dump` option is also available. A strictly text replacement for `lynx` (and more modern) is `Elinks` with several interesting options.

In order to download an off line copy of some web pages, so you can browse them later offline you can use `curl`, that can upload or download data from to or from a server. You can specify multiple URL's by ranges as in the following two examples

```
$ curl http://site.(s1,s2,s3).org
$ curl http://site.s[1-3].org
```

The copy of an entire site can be done using `wget`

```
$ wget -k -r -p http://www.interesting_site.org
```

The option `-r` recurses through the site links starting from `http://www.interesting_site.org/index.html`. The `-k` option make the links relative allowing the correct navigation through the downloaded pages. The `-p` option downloads all extra content on the page. This order makes a true mirror of a site in your computer.

Finally, the program `wput` uploads contents to internet using `FTP` as an interface and with a syntax like the `wget` one.

2.3.1 References

- 1 Upfront, Linux Journal, issue 197, September 2010 (<http://www.linuxjournal.com>)

2.4 Make files in a directory downloadable from a web server

In order that files can be listed downloaded when accessing a directory on a webserver the following line should be added to the `.htaccess` file

```
Options +Indexes
```

Be warned that the contents of all subdirectories of the directory will also be listable and downloadable...

Chapter 3

The ssh application

3.1 Removing a `known_hosts` entry

In order to remove from the `known_hosts` file the entry corresponding the the computer *hostname*, execute¹

```
ssh-keygen -R hostname
```

3.2 Generating a key pair and exporting to a remote host

If we want to access a remote node with `ssh` without providing our password, we can do so using automatic login. In order to do so, we must first check if we have a keypair already generated.

```
$ ls .ssh/  
known_hosts
```

If it is not generated, like in this example, we generate it using the command

```
$ ssh-keygen  
Generating public/private rsa key pair.  
Enter file in which to save the key (/users/home/username/.ssh/id_rsa): [press enter]  
Enter passphrase (empty for no passphrase): [press enter]  
Enter same passphrase again: [press enter]  
Your identification has been saved in /users/home/username/.ssh/id_rsa.  
Your public key has been saved in /users/home/username/.ssh/id_rsa.pub.  
The key fingerprint is:  
8b:93:61:e7:2d:4a:50:30:a3:23:7d:fc:c5:21:af:d7
```

The next step is to copy the generated public key to the remote host we want to be able to login automatically, *hostname*.

```
$ ssh-copy-id -i ~/.ssh/id_rsa.pub hostname  
36  
The authenticity of host 'hostname (XXX.163.XXX.XXX)' can't be established.  
RSA key fingerprint is 37:2b:77:61:50:0f:2a:d2:7f:da:c9:a9:10:29:37:t6.  
Are you sure you want to continue connecting (yes/no)? yes  
Warning: Permanently added 'hostname,XXX.163.XXX.XXX' (RSA) to the list of known hosts.  
Password:  
Now try logging into the machine, with "ssh 'hostname'", and check in:  
  
    .ssh/authorized_keys  
  
to make sure we haven't added extra keys that you weren't expecting.
```

And that's all. Now you can login via `ssh` without being prompted for a password.

¹The IP value can also be used instead of the computer's hostname.

3.3 Launching with `ssh` programs that require a terminal

There are some programs that cannot be launched directly with `ssh` because they require an associated terminal. For example, `mutt` or `screen`,

```
$ ssh user@server screen
Must be connected to a terminal.
```

To solve this problem there is an option in `ssh` to force pseudo-tty allocation. For example, if we want to re-attach to a previous `screen` session in the node *server* we can do

```
$ ssh -t user@server screen -dr
```

3.3.1 References

- 1 Hack and / - Lightning Hacks, Linux Journal, issue 195, July 2010 (<http://www.linuxjournal.com>)

3.4 Tunneling with `ssh`

Updated on February 20th, 2020.

The `ssh` program has the powerful feature of making the user able to establish encrypted tunnels between nodes. This is a major advantage of this extremely useful tool. There are several possibilities. Let's assume that we are user *bob* in a node called *home_box*, that has a private IP and it's behind a firewall, and we can access a second node, called *work_box*, where we are user *william*. We can connect from *home_box* to *work_box* but not the other way around. Thus, we want to make a encrypted tunnel that enables the connection from *work_box* to *home_box*. This is known as reverse `ssh` tunneling.

In order to create this tunnel we should run from *home_box*.

```
william@home_box:~$ ssh -R 9999:localhost:22 william@work_box
```

A session in *work_box* is opened, and while this session is active, the tunnel works. Then, if we log into *work_box*, we can connect to *home_box* making use of the tunnel.

```
william@work_box:~$ ssh -p 9999 bob@localhost
The authenticity of host 'localhost (127.0.0.1)' can't be established.
RSA key fingerprint is b0:b6:f3:78:e2:8d:8f:8b:3f:ab:b4:d4:da:c5:a6:e1.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'localhost' (RSA) to the list of known hosts.
bob@localhost's password:
bob@home_box:~$
```

A problem in this case is that once the initial connection is closed the tunnel collapses. A possible way to alleviate this problem is to run an application in the connection to *work_box*, e.g. `top` trying to keep the connection alive.

This is not the best option. There are better ones, for example, launching a dedicated connection with options `-f` (detach `ssh` process from `tty`), `-N` (do not execute any command over `ssh`), and `-o TCPKeepAlive=yes` to keep the connection alive.

```
william@home_box:~$ ssh -f -N -o TCPKeepAlive=yes -R 9998:localhost:22 \
william@work_box
william@home_box:~$
```

We can then connect using the new tunnel.

```
william@work_box:~$ ssh -p 9998 bob@localhost
bob@localhost's password:
bob@home_box:~$
```

Another possibility is to use the option `ServerAliveInterval`

```
william@home_box:~$ ssh -f -N -o ServerAliveInterval=5 -R 9998:localhost:22 \  
    william@work_box  
william@home_box:~$
```

This option controls the number of seconds that the client will wait before sending a null packet to the server to keep the connection alive. This is nowadays preferred to the option `TCPKeepAlive` because it is not stopped in firewalls and the information is encrypted.

3.4.1 References

- 1 howtoforge :: reverse-ssh-tunneling (<http://www.howtoforge.com/reverse-ssh-tunneling>)
- 2 SSH Tunneling Made Easy (<http://www.revsys.com/writings/quicktips/ssh-tunnel.html>)
- 3 SSH Tunneling (<http://www.linux-mag.com/id/1705>)
- 4 Breaking Firewalls with OpenSSH and PuTTY (<http://souptonuts.sourceforge.net/sshtips.htm>)

3.5 Using `ssh` to make a tarball directly in a remote folder

Created on March 13th, 2015.

You could be interested in preparing a tarball and, for lack of space or to save intermediate steps, transfer on the fly the file to a remote box. For example, let's assume that you want to transfer a directory called `data_EXP` from a computer called `laptop` to another computer called `backup_server` (I know, not very imaginative...). If our working directory is `data_EXP` parent directory we can then run

```
$ tar czf - data_EXP | ssh username@backup_server "cat > data_EXP_dir.tgz"
```


Chapter 4

Emacs text editor

4.1 Emacs macros

Updated on February 7th, 2016.

To define several emacs macros simultaneously and save them, the macros should be named. To give a macro a name define the macro and then execute `M-x (name-last-kbd-macro)` and give the macro a name¹.

The defined macro can be executed with the key combination `C-x e` unless a new macro is defined. When the last macro defined is not the one that should be executed, it should be recalled by its name as `M-x macro_name`.

If you consider the macro worth to be saved for future sessions you can open a file and save the macro in this file with the command `M-x insert-kbd-macro RET macroname RET`. You can load the file later with `load-file`.

The macro can also be added to the emacs startup file. In order to do so, open the `.emacs` file or the file where you keep emacs macros and execute `M-x (insert-kbd-macro)` giving the name of the macro to be saved.

4.1.1 References

- 1 <http://www.emacs.uniyar.ac.ru/doc/em24h/emacs112.htm>
- 2 Emacs Manual (http://www.gnu.org/software/emacs/manual/html_node/emacs/Save-Keybaord-Macro.html)

4.2 Changing the default system's text editor to Emacs

In order to change the default system's text editor to emacs or other alternative as vi in a Debian system the root user can update the system's default

```
$ sudo update-alternatives --config editor
[sudo] password for curro:

There are 4 alternatives which provide 'editor'.

  Selection    Alternative
-----
    1          /bin/ed
**+          2    /bin/nano
             3    /usr/bin/vim.tiny
             4    /usr/bin/emacs22

Press enter to keep the default[*], or type selection number: 4
Using '/usr/bin/emacs22' to provide 'editor'.
$
```

Some programs use the environment variables `$EDITOR` or `$VISUAL` to decide which editor to use. For the sake of consistency on Debian systems, these variables should be set to `/usr/bin/editor`.

¹It is interesting to prefix the macros with your initials or your username to prevent conflicts.

4.3 Removing empty lines in Emacs

Created on May 21st, 2015.

In order to remove all blank lines in a text file (or a selected text file region) you can use the command `M-x flush-lines` that removes all lines that matches a regexp condition as follows

```
M-x flush-lines RET ^$ RET
```

In case you want to remove lines containing only spaces the command is

```
M-x flush-lines RET ^\s-*$ RET
```

4.3.1 References

- 1 Mastering Emacs (<https://www.masteringemacs.org/article/removing-blank-lines-buffer>)

4.4 Reading init file .emacs

Created on December 7th, 2017.

If you perform changes in the emacs init file `.emacs` and you want to reload the definitions in an already open editor instance there are several ways to proceed:

- 1 Open emacs and then `load-file` (`M-x load-file`, then press return twice to accept the default filename, which is the current file being edited).
- 2 move the point to the end of any sexp and press `C-xC-e` to execute just that sexp. Usually it's not necessary to reload the whole file if you're just changing a line or two.
- 3 Open `.emacs` and execute `M-x eval-buffer`. It immediately evaluates all code in the buffer.

4.4.1 References

- 1 Answer from Stackoverflow (<https://stackoverflow.com/questions/2580650/how-can-i-reload-emacs-after-changing-it>)

4.5 Commenting a region of a code in Emacs

Created on February 23rd, 2016.

In order to remove comment several lines of a source code, in LaTeX, Python, Fortran, etc. select the region to comment and press `M-;`. To uncomment a region type `C-u C-;`.

4.5.1 References

- 1 Emacs manual (https://www.gnu.org/software/emacs/manual/html_node/emacs/Comment-Commands.html)

4.6 Emacs org-mode

Added on December 6th, 2017.

We include in this section information about different aspects of the Emacs text editor and its `org-mode`.

- 1 Adding a title, a subtitle, and an author name to an `org-mode` file is done in the preamble as in the following example

```
#+TITLE: Notes on the Quartic Potential
#+SUBTITLE: Quantum Cusp and Isomerization in 1D
#+AUTHOR Curro PÃ©rez-Bernal
#
#+STARTUP: latexpreview
```

The `#+STARTUP: latexpreview` command in the preamble produce a preview image of the LaTeX fragments in the text at point and overlay them over the source code. To activate `tttttttttttttttttttttt`

Adding references from a bibtex. Include a line

```
#+BIBLIOGRAPHY: refs plain
```

and call `org-reftex-citation` each time you need to include a reference.

2 Shortcuts of interest:

- 1 TAB (Shift-TAB) :: Fold-unfold parts. With Shift affects the whole file.
- 2 Alt-up/down :: move a headline up or down

4.6.1 References

- 1 <http://www.emacs.uniyar.ac.ru/doc/em24h/emacs112.htm>
- 2 Emacs Manual (http://www.gnu.org/software/emacs/manual/html_node/emacs/Save-Keyboard-Macro.html)

4.7 Definining an *unfill* function in Emacs

Created on April 8th, 2020.

We use the following function found in the Emacs wiki (see references)

```
;; Stefan Monnier <foo at acm.org>. It is the opposite of fill-paragraph
(defun unfill-paragraph (&optional region)
  "Takes a multi-line paragraph and makes it into a single line of text."
  (interactive (progn (barf-if-buffer-read-only) '(t)))
  (let ((fill-column (point-max))
        ;; This would override 'fill-column' if it's an integer.
        (emacs-lisp-docstring-fill-column t))
    (fill-paragraph nil region)))
```

Add this code to your `.emacs`. If you want to associate this function to a given combination of keys, e.g. `ESC-Q` also add

```
;; Handy key definition
(define-key global-map "\M-Q" 'unfill-paragraph)
```

4.7.1 References

- 1 Emacs Wiki (<https://www.emacswiki.org/emacs/UnfillParagraph>)

Chapter 5

Perl Language

This chapter has been translated into Spanish (<http://www.webhostinghub.com/support/es/misc/instalacion-de-perl>) language by Maria Ramos from Webhostinghub.com/support/edu (<http://www.webhostinghub.com/support/edu>).

5.1 Installing a CPAN module

There are two possible ways to install a CPAN module. We give both alternatives.

5.1.1 First alternative for installing a CPAN module

Download the CPAN module (we use the module `Devel-SmallProf-2.02` as an example) and untar it

```
# tar xzvf Devel-SmallProf-2.02.tar.gz
# cd Devel-SmallProf-2.02
Devel-SmallProf-2.02# ls
Changes  MANIFEST  META.yml  Makefile.PL  README  TODO  lib  t
```

Compile and install the module

```
Devel-SmallProf-2.02# perl Makefile.PL
Checking if your kit is complete...
Looks good
Writing Makefile for Devel::SmallProf

Devel-SmallProf-2.02# make
cp lib/Devel/SmallProf.pm blib/lib/Devel/SmallProf.pm
Manifying blib/man3/Devel::SmallProf.3pm

Devel-SmallProf-2.02# make test
PERL_DL_NONLAZY=1 /usr/bin/perl "-MExtUtils::Command::MM" "-e" "test_harness(0, 'blib/lib', 'blib/arch')" t/*.t
t/part1....ok
t/part2....ok
t/part3....ok
t/part4....ok
t/pods.....skipped
    all skipped: Only the author needs to check that POD docs are right
All tests successful, 1 test skipped.
Files=5, Tests=14, 1 wallclock secs ( 0.08 cusr + 0.01 csys = 0.09 CPU)

Devel-SmallProf-2.02# make install
Installing /usr/local/share/perl/5.8.8/Devel/SmallProf.pm
Installing /usr/local/man/man3/Devel::SmallProf.3pm
Writing /usr/local/lib/perl/5.8.8/auto/Devel/SmallProf/.packlist
Appending installation info to /usr/local/lib/perl/5.8.8/perllocal.pod
```

5.1.2 Second alternative for installing a CPAN module

In this case we use an interactive shell that we launch as

```
# perl -MCPAN -e shell
```

The first time the shell is launched the system has to be configured and upgraded. The system prompts for several programs (unzip, etc.). Install them if they are not already installed in the computer. Select a repository (in my case `ftp://ftp.rediris.es/mirror/CPAN`) and most questions can safely answered using the default choice.

The first thing to do after configuration is to upgrade your CPAN:

```
cpan> install Bundle::CPAN

CPAN: Storable loaded ok
Fetching with LWP:
ftp://ftp.rediris.es/mirror/CPAN/authors/01mailrc.txt.gz
Going to read /root/.cpan/sources/authors/01mailrc.txt.gz
CPAN: Compress::Zlib loaded ok
Fetching with LWP:
ftp://ftp.rediris.es/mirror/CPAN/modules/02packages.details.txt.gz
.
.
.
```

Then you reload it:

```
cpan> reload cpan
```

And install the required module, `Roots` in this example:

```
cpan> install Math::Function::Roots

.
.
.

Appending installation info to /usr/lib/perl/5.8/perllocal.pod
/usr/bin/make install -- OK
```

5.2 Interesting perl oneliners

Updated on March 5th, 2017.

Updated on October 29th, 2016.

Updated on May 21st, 2015.

Updated on January 31st, 2015.

- 1 Execute a program, in this case `epstopdf`, using as an input all files sharing an common extension , in this case `eps`, in the current directory.

```
perl -e 'system "epstopdf $_" for (glob "*.eps");'
```

- 2 Erasing “phantom” files with 0 bytes size.

```
perl -e 'foreach (glob "*") \
{unless (-s $_) {"Deleting $_\n";unlink "$_";}}'
```

- 3 Checking Postscript files referred in a LaTeX output message.

```
latex filename.tex | perl -e \
'while (<>){foreach (split) {/<(.?\.\eps)/ and push(@eps, $1)}};\
foreach (sort @eps) {print;print "\n"}'
```

- 4 Print apostrophe character.

```
perl -le 'print "'\'' is an apostrophe...'''
```

- 5 Changing a text file from UTF-8 encoding to ASCII. Note that it does not work for Spanish accented characters.

```
perl -ne 'for (unpack "U*", $_) \
{ printf $_ > 128 ? "x" : "%c", $_ }' fileUTF.txt > fileASCII.txt
```

- 6 Adding an E character to the output of Fortran programs with three digits in the exponent that lacks this character.

```
perl -pi'.bak' -e 's/(\d)-(\d\d\d)/$1E-$2/g' fort.output
```

- 7 Delete empty lines in a file.

```
perl -ni -e 'chomp($_);print "$_\n" if ($_)' test.dat
```

- 8 Makes a substitution in a file, in the selected example substitute the word *figures* by *Figures* in all files with extension *tex* in the current directory.

```
perl -pi'.bak' -e 's/figures//Figures//g' *.tex
```

- 9 Counting the number of words per line in a file. If the filename is *test.out* then

```
perl -n -e 'my @line = split;print scalar @line,"\n"' test.out
10000
202
10000
202
10000
202
10000
202
10000
202
10000
202
```

- 10 Join even lines at the end of odd lines in a file. If the filename is *test.out* then we can count the number of words in each line prior and after the merging.

```
perl -n -e 'my @line = split;print scalar @line,"\n"' test.out
10000
202
10000
202
10000
202
202
perl -n -e 'chomp; $_ ? print "$_ " : print "$_\n";' test.out > test2.out
perl -n -e 'my @line = split;print scalar @line,"\n"' test2.out
10202
10202
10202
```

- 11 Search and display occurrences in a log file (*/var/log/loginlog.0* in this example) of succesful logins of user *curro*, showing the number of times the user has logged from each machine.

```
perl -e 'while (<>) {
if (m|\d+:\d+:\d+\s+(.*?)\s+.*ccepted.*curro\s+from\s+(.*?)\s+.*|)
{$vh{"$1 from $2"}++;} }
foreach (keys %vh)
{print "$vh{$_} login(s) to $_\n";}' /var/log/loginlog.0
```

- 12 Count the number of files in a directory.

In the first example we use globbing to count the total number of files including hidden files or the number of files subject to some restriction.

```
$ perl -e 'my @files = glob "*.*"; print 1+$#files."\n"'
129
$ perl -e 'my @files = glob "l*gif"; print 1+$#files."\n"'
9
```

The same can be accomplished using directory handles and *grep*

```
$ perl -e 'opendir DH, ".";my @files = readdir DH; print 1+$#files."\n"'
129
$ perl -e 'opendir DH, ".";my @files = grep /^l.*.gif$/, (readdir DH); print 1+$#files."\n"'
9
```

- 13 Get the last line of a file.

We include a oneliner that gets the last line of a series of files

```
perl -e 'foreach (@ARGV) {my $line = `tail -n 1 $_`; print $line}' output_notes_1* output_notes_2* output_notes_3* ...
```

In the original application the line was prepended with a number appearing in the filename as follows

```
perl -e 'foreach (@ARGV) {/.*(\d\d).*/;my $line = $1.`tail -n 1 $_`; print $line}' output_notes_1* output_notes_2* output_not
```

14 Change Mac carriage return to UNIX new line

Let's assume we have a bunch of csv files with Mac carriage return that our system interprets as a very long unique line. Instead of using `emacs` we can easily fix this with

```
perl -pi -e 's/\r/\n/g' *.csv
```

15 Extract the figure names from a LaTeX compile output and prepare a tarball with the figure files.

We assume that we compile a file called `rdiary_2014.tex` and all figs are in a directory called `Figs` and are `png` files. We use two pipes, the first one connect the output of `pdflatex` with a perl oneliner that reads the standard input and extract the file names. A second pipe sends to `tar` the file names. Notice the `-T` options.

```
pdflatex rdiary_2014.tex | perl -e 'while (<>) {print "$1\n" if /<.*(F.*png).*>/g}' | tar czf figs.tgz -T -
```

16 We have two files, each with two columns of data in an X Y format. Let's say `File_1` with `X1 Y1` and `File_2` with `X2 Y2`. The abscissa are common and we want to create a third file with called `File_3` with three columns and the following format: `X1 Y1 Y2`.

```
perl -e '@fhs=map { open my $fh, "<", $_; $fh } @ARGV; $f0 = $fhs[0]; $f1 = $fhs[1]; while (!$done) { $done=1; chomp($l0=<$f0>); $l1=<$f1>; do { @l11 = split " ", $l1; print "$l0 $l11[-1]";
```

5.3 Environment Codification and Character Ordering

The following short script permit to test a terminal codification.

```
#!/usr/bin/perl
use warnings;
use strict;
use Encode;
my @charsets = qw(utf-8 latin1 iso-8859-15 utf-16);
# some non-ASCII codepoints:
my $test = 'Ue: ' . chr(220) .'; Euro: ' . chr(8364) . "\n";
#
for (@charsets){print "$_: " . encode($_, $test);}
```

Once the script is run, different lines appear, and the terminal charset is the one of the line correctly displayed. For example, if we execute the script in a terminal using the UTF-8 coding system the output is something similar to

```
$ encodings.plx
utf-8: Ue: Ã; Euro: â¬
latin1: Ue: ÿ½; Euro: ?
iso-8859-15: Ue: ÿ½; Euro: ÿ½
utf-16: ÿ½ÿ½Ue: ÿ½; Euro: ÿ½
```

Note that both special characters, `Ã` and the euro symbol, only appear in correcto form in the `utf-8` charset line.

The function `chr` in Perl takes a number as an argument and returns the character represented by that NUMBER in the selected character set. The function `encode` allows the codification of the character is different character sets. The four most common character sets are the ones included in the former example.

Another problem with character sets arise when ordering alphabetically a set of words of characters when the characters in the set are not the standard 127 ASCII character. For example, suppose that we are trying to order alphabetically the following set of names

```
Ãlvarez
MÃÃnguez
PÃÃrez
Perales
Pilar
Mola
Borrero
DÃÃaz
Diz
Delgado
Cuesta
Castro
CÃ;Ã±amo
```


A standard program, comparing with the `cmp` function is as follows

```
#!/usr/bin/perl
use strict;
use warnings;
#
my @names;
#
while (defined(my $line = <>)) {
    chomp($line);
    my $elem = push(@names,$line);
    print "$elem element(s) added\n";
}
#
print "Reading process finished. Sorting ... ";
#
print "Done.\n\n";
print "Sorted set of names:\n";
foreach (sort by_name @names) {
    print "\t$_\n";
}
#
sub by_name {$a cmp $b}
```

However, when we run the program we obtain the somewhat surprising output

```
Sorted set of names:
Borrero
Castro
Cuesta
CÃ;Ã±amo
Delgado
Diz
DÃaz
Mola
MÃnguez
Perales
Pilar
PÃrez
Ãlvarez
```

Clearly this is not the expected output if we intend to sort alphabetically (using Spanish sorting rules). The reason of this unexpected behavior is that the `cmp` function compares non-ASCII chars by codepoint number¹, which might give unexpected results. In order to sort according to a particular language convention we should use the `locale` pragma. The previous program can be rewritten as follows

```
#!/usr/bin/perl
use strict;
use warnings;
#
#####
use locale;
use POSIX qw(locale_h);
setlocale(LC_COLLATE, 'es_ES@euro') or die "Locale es_ES@euro not installed.\n";
#####
#
#
my @names;
#
while (defined(my $line = <>)) {
    chomp($line);
    my $elem = push(@names,$line);
    print "$elem element(s) added\n";
}
#
print "Reading process finished. Sorting ... ";
#
print "Done.\n\n";
print "Sorted set of names:\n";
foreach (sort by_name @names) {
    print "\t$_\n";
}
#
sub by_name {$a cmp $b}
```

After this change the word order is the usual one in Spanish.

```
Sorted set of names:
Ãlvarez
```

¹From Wikipedia: In character encoding terminology, a code point or code position is any of the numerical values that make up the code space. For example, ASCII comprises 128 code points in the range 0hex to 7Fhex, Extended ASCII comprises 256 code points in the range 0hex to FFhex, and Unicode comprises 1,114,112 code points in the range 0hex to 10FFFFhex.

```
Borrero
CÃ;Ã±amo
Castro
Cuesta
Delgado
DÃaz
Diz
MÃnguez
Mola
Perales
PÃrez
Pilar
```

5.3.1 References

- 1 <http://perlgeek.de/en/article/encodings-and-unicode>
- 2 <http://perldoc.perl.org/perllocale.html#USING-LOCALES>

5.4 Extracting matches from a regular expressions

This can be easily done using the grouping metacharacters `'()`'. They allow the extraction of the parts of a string that matched the imposed condition. Each grouping marked by parentheses goes into a special variable `$1`, `$2`, etc. They can be used as ordinary variables.

If we want to extract the day, month and year from a date expressed as *dd/mm/yyyy* we can do the following

```
# extract day, month, year
if ($date =~ m!(\d\d)/(\d\d)/(\d\d\d\d)!) { # match dd/mm/yyyy format
    $day = $1;
    $month = $2;
    $year = $3;
}
```

Note the use of the pattern match operator `m!!` to change the standard pattern delimiters. We can rewrite in a shorter form the previous code, taking advantage of the different behavior of the binding operator in scalar and list contexts.

In scalar context the binding operator returns a true or false value.

```
$answer = $date =~ m!(\d\d)/(\d\d)/(\d\d\d\d)!
```

Thus *\$answer* equals to one or zero. In list context, however, the binding operator returns the list of matched values (`$1`, `$2`, `$3`, ...). Thus we can abbreviate the previous code as

```
($day,$month,$year) = ($date =~ m!(\d\d)/(\d\d)/(\d\d\d\d)!)
```

If the groupings in a regexp are nested, `$1` gets the group with the leftmost opening parenthesis, `$2` the next opening parenthesis, etc.

For more information: `man perlretut`.

5.5 Basic use of `fork` to launch a program

Apart from the `system` utility, a Perl script can launch child processes using the `fork` utility. Let's assume that we are interested in launching applications, called `fort_1` and `fort_2` from a script, but we are not interested in waiting for the end of the application. Using `fork` we can do the following in our script

```
defined(my $pid0 = fork) or die "Cannot fork: $!";
unless ($pid0) {
    # Child 0 process is here
    exec "fort_1";
    die "cannot exec fort_1: $!";
}
defined(my $pid1 = fork) or die "Cannot fork: $!";
unless ($pid1) {
    # Child 1 process is here
    exec "fort_2";
    die "cannot exec fort_2: $!";
}
```

```

}
print "Program output: \n";
# Parent processes are here
# script continues ...
waitpid($pid0, 0);
waitpid($pid1, 0);

```

Only the parent process has a non-zero value in `$pid0` and `$pid1` and skip the two `unless` conditionals. The program arrives to the `waitpid` function. This function waits for a particular child process to terminate and returns the pid of the deceased process. It is important to do so in order to get rid of zombie processes.

For more information: `man perlipc`.

5.6 Perl predefined variables. Some examples.

Apart from the ubiquitous Perl default variable, `$_` there is a large number of useful predefined variables. We give some examples of them in the following short codes.

1 `$.`

Current line number for the last filehandle accessed.

The following code displays each line of the file and the corresponding line number.

```

#
open(INPUT, "</etc/motd") or die "/etc/motd: $!";
#
while (<INPUT>) {
    print "Line $.: $_";
}

```

2 `$0`

Name of the program being executed.

The following code removes directories preceding the program name and stores it in a variable called `$prgname`

```

#
(my $prgname) = $0 =~ m#.#/(.+)$#;
#

```

For more information: `man perlvar`.

5.7 Using a named pipe for interprocess communication in Perl

A named pipe (or `fifo` file) can be used for interprocess communication between a parent process and a child process or children processes. Let's suppose that we forked and launched a couple of child processes 'Basic use of `fork` to launch a program' on the preceding page and we want to check whether each of the child processes has finished. Once the first process finishes we execute the `waitpid`. It is not efficient to directly execute `waitpid` because we do not know which of the processes will finish first.

A commented sample of code that manages to do so, launching a couple of child processes and waiting for each of them to finish is the following

```

#!/usr/bin/perl
#
# named pipe use for ipc example
#
# by Currix TM
#
use strict;
use warnings;
use POSIX qw(mkfifo);
#
# fifo definition
my $FIFOname = ".prgfifo";
unless (-p $FIFOname) { # Create the pipe if it doesn't exist
    unlink $FIFOname;
    mkfifo($FIFOname, 0700) or die "mkfifo in the current directory failed: $!";
}
#
my @pid;

```

```

#
print "This is the parent process before forking with pid $$\n";
#
defined ($pid[0]=fork) or die "Cannot fork (1): $!";
#
#
unless ($pid[0]) {
    print "fork1 pid: $pid[0]\n";
    print "fork1 ps: $$\n";
    sleep 10; # Sleeeeeeeeping
    system "cat /etc/motd";
#   Child process ended. Write process number in the FIFO
    open (FIFO, ">$FIFOname") || die "can't write prgfifo: $!";
    print FIFO "$$";
    sleep 2;    # to avoid dup signals
    print "Exiting child 1\n";
    exit(0) # Remember to cleanly close the child process
} else {
    print "This is the parent process after forking 1 with pid: $pid[0]\n";
}
#
defined ($pid[1]=fork) or die "Cannot fork (2): $!";
#
#
unless ($pid[1]) {
    print "fork2 pid: $pid[1]\n";
    print "fork2 ps: $$\n";
    sleep 5; # Sleeeeeeeeping
    system "cat /etc/fstab";
#   Child process ended. Write process number in the FIFO
    open (FIFO, ">$FIFOname") || die "can't write prgfifo: $!";
    print FIFO "$$";
    sleep 1;    # to avoid dup signals
    print "Exiting child 2\n";
    exit(0); # Remember to cleanly close the child process
} else {
    print "This is the parent process after forking 2 with pid: $pid[1]\n";
}
#
print "This are the pids from the parent process after forking: $pid[0], $pid[1]\n";
#
my $iprocess = 0;
open (FIFO, "<$FIFOname") || die "can't read prgfifo: $!";
while (1) {
    my $kidpid = <FIFO>;
    if (defined $kidpid) {
        print "child process $kidpid ended\n";
        sleep 2; # To avoid dup signals again
        waitpid($kidpid, 0);
        last if (++$iprocess) == 2;
    }
}
#
print "The two child processes have finished. Closing the parent process.\n";
#
unlink("$FIFOname"); # Remove the named pipe

```

For more information: `man perlipc` and references below.

5.7.1 References

- 1 Perldoc website (<http://perldoc.perl.org/perlipc.html>)

5.8 CPerlMode in Emacs

The CPerlMode can be set as the standard mode for editing Perl adding the following line to the `.emacs` configuration file:

```
(defalias 'perl-mode 'cperl-mode)
```

To access the documentation about the mode use the `describe-mode` function by typing `C-h m` when in CPerlMode. When not in CPerlMode use `M-x describe-function RET cperl-mode` or `C-h f cperl-mode`.

5.8.1 References

- 1 Emacs wiki (<http://www.emacswiki.org/emacs/CPerlMode>)

5.9 Using Perl to benchmark code.

The `Benchmark` module included in the base Perl distribution includes a series of procedures to benchmark running times of code.

Some of the available procedures are the following²

- `timethis`: run a chunk of code several times.
- `timethese`: run several chunks of code several times.
- `cmpthese`: print results of `timethese` as a comparison chart (*).
- `timeit`: run a chunk of code and see how long it goes (*).
- `countit`: see how many times a chunk of code runs in a given time (*).

The procedures marked with an asterisk (*) are not included by default and should be explicitly loaded.

Two of the most useful options are `timethese` and `cmpthese`.

The `timethese` procedure runs several chunks of code several times. The syntax is

```
timethese($count, {
  'Name1' => sub { ...code1... },
  'Name2' => sub { ...code2... },
});
```

If the argument `$count` is a positive integer it gives the number of times the code is run, a negative integer indicates the minimum number of CPU seconds to run³. The minimum in this case is 0.1 sec. If `$count` is zero a default value of 3 CPU seconds is assumed.

The output of `timethese` is an object that can be used as an input for `cmpthese`.

We apply this to the following example, comparing different ways of calculating the square of a number.

```
#!/usr/bin/perl
use strict;
use warnings;
use Benchmark qw( timethese cmpthese );
my $x = 3.1;
my $CNT = -6;
my $r = timethese( $CNT, {
  a => sub { $x*$x },
  b => sub { $x**2 },
  c => sub { exp(2*log($x)) }
} );
cmpthese $r;
$CNT=40_000_000;
$r = timethese( $CNT, {
  a => sub { $x*$x },
  b => sub { $x**2 },
  c => sub { exp(2*log($x)) }
} );
cmpthese $r;
```

The procedures are run twice, the first with `$count=-6` and the second with `$count=40_000_000`.

In the first case the `timethese` output is the following

```
Benchmark: running a, b, c for at least 6 CPU seconds...
 a:  8 wallclock secs ( 7.07 usr +  0.00 sys =  7.07 CPU) @ 17313412.45/s (n=122405826)
 b:  7 wallclock secs ( 6.13 usr + -0.02 sys =  6.11 CPU) @ 12221032.41/s (n=74670508)
 c:  6 wallclock secs ( 6.39 usr +  0.00 sys =  6.39 CPU) @ 3914053.68/s (n=25010803)
```

In these case the real (wallclock) time is given, and also the distribution of the addition of the time spent by the user and the system to accomplish the CPU time goal⁴. In case the program spawns one or more children processes the `cusr` and `csys` times are also given. The number after the @ symbol is the number of iterations per second and `n` is the total number of iterations. Thus the larger the better in these two last cases. The first version of the code can be concluded to be more efficient. This is more easily denoted using the `cmpthese` output. It gives in increasing order the number of iterations per second and the percentage of improvement (positive) or worsening (negative value) compared to the other options.

²There are other possibilities. Check the References.

³CPU seconds is, in UNIX terms, the user time plus the system time of the process itself, as opposed to the real (wallclock) time and the time spent by the child processes.

⁴For an explanation of the different times reported check this link Process time (http://en.wikipedia.org/wiki/Process_time)

```

      Rate      c      b      a
c 3914054/s  -- -68% -77%
b 12221032/s 212%  -- -29%
a 17313412/s 342% 42%  --

```

In this case the codes are ordered starting on the slowest (c in this case), giving in Rate the iterations per second and the percentages of comparison of the rate with the rate of the other codes under evaluation.

If the \$count argument is positive the code is executed the number of times indicated by the argument. If this number is high enough the results should coincide with the previously obtained.

```

enchmark: timing 40000000 iterations of a, b, c...
a: 2 wallclock secs ( 1.90 usr + -0.01 sys = 1.89 CPU) @ 21164021.16/s (n=40000000)
b: 3 wallclock secs ( 3.25 usr + 0.00 sys = 3.25 CPU) @ 12307692.31/s (n=40000000)
c: 10 wallclock secs (10.16 usr + 0.00 sys = 10.16 CPU) @ 3937007.87/s (n=40000000)
      Rate      c      b      a
c 3937008/s  -- -68% -81%
b 12307692/s 213%  -- -42%
a 21164021/s 438% 72%  --

```

The output will vary even for the same box, and several runnings are sometimes necessary to get a final answer. Also the output vary from box to box. If the same code is run in a different computer we obtain

```

Benchmark: running a, b, c for at least 6 CPU seconds...
a: 7 wallclock secs ( 6.18 usr + 0.00 sys = 6.18 CPU) @ 19332920.23/s (n=119477447)
b: 7 wallclock secs ( 7.25 usr + 0.00 sys = 7.25 CPU) @ 10521698.76/s (n=76282316)
c: 8 wallclock secs ( 6.96 usr + 0.00 sys = 6.96 CPU) @ 4018543.53/s (n=27969063)
      Rate      c      b      a
c 4018544/s  -- -62% -79%
b 10521699/s 162%  -- -46%
a 19332920/s 381% 84%  --
Benchmark: timing 40000000 iterations of a, b, c...
a: 2 wallclock secs ( 0.77 usr + 0.00 sys = 0.77 CPU) @ 51948051.95/s (n=40000000)
b: 2 wallclock secs ( 2.40 usr + 0.00 sys = 2.40 CPU) @ 16666666.67/s (n=40000000)
c: 9 wallclock secs ( 9.40 usr + 0.00 sys = 9.40 CPU) @ 4255319.15/s (n=40000000)
      Rate      c      b      a
c 4255319/s  -- -74% -92%
b 16666667/s 292%  -- -68%
a 51948052/s 1121% 212%  --

```

5.9.1 References

- 1 Perldoc Benchmarc Entry (<http://perldoc.perl.org/Benchmark.html>)
- 2 Benchmarking in techrepublic (<http://www.techrepublic.com/article/benchmarking-perl-scripts-with-b5278558>)
- 3 Process time (http://en.wikipedia.org/wiki/Process_time)

5.10 Accessing recursively files and directories in Perl

Added on November 22nd, 2012.

The easiest way in Perl to access files and directories recursively is making use of the `File::Find` module. For example let's assume that we want to, recursively, change the permissions of a given directory contents in such a way that files have `rw-r----` permission and directories `rxwxr-x--`.

We can do this with the following script, than makes use of the `File::Find` module.

```

#!/usr/bin/perl
#
# script to process recursively a directory.
# by Currix TM.
use strict;
use warnings;
#
use File::Find;
#
sub process_files {
    my $permission_dir = 0750;
    my $permission_file = 0740;
    if (-d $_) {
        #print "processing dir $_\n";
    }
}

```

```

    chmod $permission_dir, $_;
} elsif (-f $_) {
    #print "\tprocessing file $_\n";
    chmod $permission_file, $_;
}
}
@ARGV = qw(.) unless @ARGV;
find(\&process_files, @ARGV);

```

Notice that the `chmod` function in Perl needs that the permission are expressed in octal values. Note also the lack of apostrophes in the permission variables definition.

5.11 Correct way of opening filehandles in Perl

Added on December 17th, 2018.

If we need to open for reading a file whose name is encoded in the variable *\$filename*, we create a variable for the filehandle name *\$fh*, and we want to stop the program if the file does not exist, we should use something similar to the following example:

```

use strict;
use warnings;

my $filename = 'data.txt';
open(my $fh, '<:encoding(UTF-8)', $filename)
    or die "Could not open file '$filename' $!";

while (my $row = <$fh>) {
    chomp $row;
    print "$row\n";
}

```

Notice that the `open` function has three arguments and instead of using only the symbol `<` for reading the encoding is provided.

In early Perl versions (prior to 2000) the standard way of doing this would be

```

use strict;
use warnings;

my $filename = 'data.txt';
open(IN, "<$filename")
    or die "Could not open file '$filename' $!";

while (my $row = <IN>) {
    chomp $row;
    print "$row\n";
}

```

In this case only two arguments are given for `open`. The filehandle is `IN`, a global bareword that is not caught by the `use strict` pragma. The problem with this old fashion way is

- 1 `IN` is global to all the script with possible clashes.
- 2 It is difficult to pass the filehandle to functions and subroutines as an argument.
- 3 Having two parameters the filename variable can make possible to experience unexpected side effects. For example defining `$filename = ">/etc/crontab"` and making possible to modify this file (hopefully you do not run as root your scripts...).

Same apply for writing...

5.11.1 References

- 1 PerlMaven.com (<https://perlmaven.com/open-files-in-the-old-way>)

Chapter 6

Fortran Tips and Templates

6.1 Compile and install the LAPACK95 interface driver routine.

Updated on February 22nd, 2018.

Updated on September 16th, 2011.

This howto was checked initially in a Debian Squeeze box, with a gfortran 4.4.5 compiler and in a Ubuntu Lucid Lynx with a compiler gfortran 4.4.3. Last version has been checked in a Debian Stretch box, with a gfortran 6.3.0 compiler.

In this howto we install from scratch the Fortran 77 libraries BLAS and LAPACK, and then compile the FORTRAN 95 extension to LAPACK. Both Debian and Ubuntu systems provide BLAS and LAPACK libraries as native packages and this first step could be skipped and you can ignore next two paragraphs. In any case it may be interesting to compile all the libraries with optimized flags for the system in question.

First we should upload the LAPACK and LAPACK 95 libraries, for example from the *Netlib* website (LAPACK *tgz* from Netlib (<http://www.netlib.org/lapack/lapack-3.3.1.tgz>), (LAPACK95 *tgz* from Netlib (<http://www.netlib.org/lapack95/lapack95.tgz>)). The LAPACK version we will install is 3.3.1.

```
$ wget -c http://www.netlib.org/lapack/lapack-3.3.1.tgz
--2011-09-16 13:49:37-- http://www.netlib.org/lapack/lapack-3.3.1.tgz
Resolving www.netlib.org... 160.36.58.108
.
.
.
2011-09-16 13:49:48 (439 KB/s) - 'lapack-3.3.1.tgz' saved [4945204/4945204]

$ wget http://www.netlib.org/lapack95/lapack95.tgz
--2011-09-16 13:49:54-- http://www.netlib.org/lapack95/lapack95.tgz
.
.
.
2011-09-16 13:49:59 (368 KB/s) - 'lapack95.tgz' saved [1579613/1579613]
```

Untar the LAPACK library tarball.

```
$ tar xzf lapack-3.3.1.tgz
$ cd lapack-3.3.1/
lapack-3.3.1$
```

Edit the file `make.inc` to a file conveniently tuned for your system. A working example for `gfortran` is shown in 'make.inc for LAPACK compilation' on the next page. The library can now be compiled, starting with the compilation of the included BLAS library

```
lapack-3.3.1$ cd BLAS/SRC
lapack-3.3.1/BLAS/SRC$ make
.
.
.
zhemm.o zherk.o zher2k.o lsame.o xerbla.o xerbla_array.o
ranlib ../../blas_linux_gfortran.a
lapack-3.3.1/BLAS/SRC$
```

The next step is the compilation of the BLAS library

```

lapack-3.3.1/BLAS/SRC$ cd ../../
lapack-3.3.1$ make
.
.
.
make[1]: Leaving directory `/home/curro/1/lapack-3.3.1/BLAS/TESTING'
( cd BLAS; ./xblat3s < sblat3.in      ; \
  ./xblat3d < dblat3.in      ; \
  ./xblat3c < cblat3.in      ; \
  ./xblat3z < zblat3.in      )
lapack-3.3.1$ ls *.a
blas_linux_gfortran.a  lapack_linux_gfortran.a  tmglib_linux_gfortran.a

```

The next step is to copy the compiled libraries to their final destination

```

lapack-3.3.1$ sudo mkdir /usr/local/lapack-3.3.1
[sudo] password for curro:
lapack-3.3.1$ sudo cp *.a /usr/local/lapack-3.3.1/

```

We now proceed to compile and install the LAPACK 95 library. This is where you should start if you are using the BLAS and LAPACK provided by the distribution. First we unpack the LAPACK 95 tarball and edit the `make.inc` file. A working example for gfortran is shown in ‘`make.inc` for LAPACK95 compilation’ on the facing page.

```

$ tar xzf lapack95.tgz
$ cd LAPACK95/
LAPACK95$ cd SRC
LAPACK95/SRC$ make single_double_complex_dcomplex
.
.
.
ranlib ../lapack95.a
rm -fr ../lapack95_modules
mkdir ../lapack95_modules
'cp' *.mod ../lapack95_modules/
rm -f f77_lapack.* f95_lapack.*
rm -f *_lapack_single_double_complex_dcomplex.o
LAPACK95/SRC$

```

The final step is to copy the libfile and modules to a convenient location.

```

LAPACK95$ sudo mkdir /usr/local/lib/lapack95
LAPACK95$ sudo cp -r lapack95.a lapack95_modules /usr/local/lapack95

```

We include a program template invoking this library in ‘Example of program using LAPACK95’ on page 62 and a makefile that can be used to compile this program in ‘makefile for compiling programs with calls to LAPACK95’ on page 62.

6.1.1 `make.inc` for LAPACK compilation

```

# -*- Makefile -*-
#####
# LAPACK make include file.                                     #
# LAPACK, Version 3.3.1                                         #
# April 2011                                                    #
#####
#
# See the INSTALL/ directory for more examples.
#
SHELL = /bin/sh
#
# The machine (platform) identifier to append to the library names
#
PLAT = _linux_gfortran
#
# Modify the FORTRAN and OPTS definitions to refer to the
# compiler and desired compiler options for your machine. NOOPT
# refers to the compiler options desired when NO OPTIMIZATION is
# selected. Define LOADER and LOADOPTS to refer to the loader
# and desired load options for your machine.
#
FORTRAN = gfortran -O2 -m32
OPTS =
DRVOPTS = $(OPTS)
NOOPT = -g -O0
LOADER = gfortran -g
LOADOPTS =
#
# Timer for the SECOND and DSECND routines
#
# Default : SECOND and DSECND will use a call to the EXTERNAL FUNCTION ETIME
# TIMER = EXT_ETIME

```

```

# For RS6K : SECOND and DSECND will use a call to the EXTERNAL FUNCTION ETIME_
# TIMER      = EXT_ETIME_
# For gfortran compiler: SECOND and DSECND will use a call to the INTERNAL FUNCTION ETIME
TIMER        = INT_ETIME
# If your Fortran compiler does not provide etime (like Nag Fortran Compiler, etc...)
# SECOND and DSECND will use a call to the Fortran standard INTERNAL FUNCTION CPU_TIME
# TIMER      = INT_CPU_TIME
# If neither of this works...you can use the NONE value... In that case, SECOND and DSECND will always return 0
# TIMER      = NONE
#
# The archiver and the flag(s) to use when building archive (library)
# If you system has no ranlib, set RANLIB = echo.
#
ARCH          = ar
ARCHFLAGS= cr
RANLIB        = ranlib
#
# The location of BLAS library for linking the testing programs.
# The target's machine-specific, optimized BLAS library should be
# used whenever possible.
#
BLASLIB       = ../../blas$(PLAT).a
#
# Location of the extended-precision BLAS (XBLAS) Fortran library
# used for building and testing extended-precision routines. The
# relevant routines will be compiled and XBLAS will be linked only if
# USEXBLAS is defined.
#
# USEXBLAS     = Yes
XBLASLIB      =
# XBLASLIB     = -lxblas
#
# Names of generated libraries.
#
LAPACKLIB      = lapack$(PLAT).a
TMGLIB         = tmglib$(PLAT).a
EIGSRCCLIB     = eigsrc$(PLAT).a
LINSRCLIB      = linsrc$(PLAT).a

```

6.1.2 make.inc for LAPACK95 compilation

```

#
# -- LAPACK95 interface driver routine (version 2.0) --
#      UNI-C, Denmark; Univ. of Tennessee, USA; NAG Ltd., UK
#      August 5, 2000
#
FC = gfortran
FC1 = gfortran
# -dcfuns  Enable recognition of non-standard double
#          precision complex intrinsic functions
# -dusty   Allows the compilation and execution of "legacy"
#          software by downgrading the category of common
#          errors found in such software from "Error" to
# -ieee=full enables all IEEE arithmetic facilities
#          including non-stop arithmetic.
OPTS0 = -O3
MODLIB = -I../../lapack95_modules
OPTS1 = -c $(OPTS0)
OPTS3 = $(OPTS1) $(MODLIB)
OPTL = -o
OPTLIB =

#LAPACK_PATH = /usr/local/lib/LAPACK3/

LAPACK95 = ../../lapack95.a
LAPACK77 = -llapack
BLAS = -lblas

LIBS = $(LAPACK95) $(LAPACK77) $(BLAS)
SUF = f90

XX = 'rm' -f $@; \
      'rm' -f $@.res; \
      $(FC) $(OPTS0) -o $@ $(MODLIB) $@.$(SUF) $(OPTLIB) $(LIBS); \
      $@ < $@.dat > $@.res; \
      'rm' -f $@

YY = $(FC) $(OPTS0) -o $@ $(MODLIB) $@.$(SUF) $(OPTLIB) $(LIBS)

.SUFFIXES: .f90 .f .o

.$(SUF).o:
$(FC) $(OPTS3) $<

.f.o:
$(FC1) $(OPTS3) $<

```

6.1.3 Example of program using LAPACK95

This source should be saved in a file called `ejemplo_la_spsv.f90` to use the Makefile provided in n ‘makefile for compiling programs with calls to LAPACK95’ on the current page.

```
PROGRAM LA_SSPSV_EXAMPLE

!  -- LAPACK95 EXAMPLE DRIVER ROUTINE (VERSION 1.0) --
!
! .Use Statements
USE LA_PRECISION, ONLY: WP => SP
USE F95_LAPACK, ONLY: LA_SPSV
! Implicit Statement
IMPLICIT NONE
! Local Scalars
INTEGER :: I, N, NN, NRHS
! Local Arrays
INTEGER, ALLOCATABLE :: IPIV(:)
REAL(WP), ALLOCATABLE :: B(:, :), AP(:)
! Executable Statements
WRITE(*,*) 'SSPSV Example Program Results.'
N = 5; NRHS = 1
WRITE(*, '(5H N = , I4, 9H; NRHS = , I4)') N, NRHS
NN = N*(N+1)/2
ALLOCATE ( AP(NN), B(N,NRHS), IPIV(N) )
!
CALL RANDOM_NUMBER(AP)
AP = 10*AP
!
WRITE(*,*) 'Matrix AP : '
DO I=1,NN; WRITE(*, "(15(I3,1X,1X),I3,1X)") INT(AP(I));
ENDDO
!
WRITE(*,*) 'Matrix B : '
CALL RANDOM_NUMBER(B)
B = 10*B
DO I=1,N; WRITE(*, "(10(I3,1X,1X),I3,1X)") INT(B(I,1));
ENDDO
!
WRITE(*,*) " CALL LA_SPSV( AP, B, 'L', IPIV )"
!
CALL LA_SPSV( AP, B, 'L', IPIV )
!
WRITE(*,*) 'AP on exit: '
DO I=1,NN; WRITE(*, "(15(E13.5))") AP(I);
ENDDO
!
WRITE(*,*) 'Matrix B on exit : '
DO I=1,N; WRITE(*, "(F9.5)") B(I,1);
ENDDO
!
WRITE(*,*) 'IPIV = ', IPIV
!
END PROGRAM LA_SSPSV_EXAMPLE
```

6.1.4 makefile for compiling programs with calls to LAPACK95

```
#
#  -- LAPACK95 makefile (version 1.0) --
#
FC = gfortran
#
MODLIB = -I/usr/local/lib/lapack95_modules
OPTS1 = -c
OPTS3 = $(OPTS1) $(MODLIB)
OPTL = -o
OPTLIB = -lblas -llapack

LAPACK_PATH = /usr/local/lib
LAPACK95_PATH = /usr/local/lib

LAPACK95 = $(LAPACK95_PATH)/lapack95.a

LIBS = $(LAPACK95)
SUF = f90

YY = $(FC) -o $@ $(MODLIB) $@.$(SUF) $(OPTLIB) $(LIBS)

.SUFFIXES: .f90 .f .o

.$(SUF).o:
$(FC) $(OPTS3) $<

ejemplo_la_spsv:
$(YY)

clean:
'rm' -f *.o *.mod core
```

6.2 Compile and link statically with NAG and LAPACK

It is important to be able to compile and link statically programs when libraries are not available in all nodes. This is the case with the NAG library which is not compatible with `gfortran`, the only Fortran compiler in Debian Lenny. The program statically linked in one node (where Etch is installed and `g77` is available) can be executed in any other node.

An example of compilation is the following

```
g77 -static -o infsq_box_1D infsq_box_1D.f ../Potentials/wsaxon_Box_pot.f -L /usr/lib/atlas -L/usr/local2/NAG -lnag -llapack -lblas
```

Some important points:

- 1 It is necessary to include both Lapack and Blas libraries.
- 2 The Blas library should be `blas-3`.
- 3 The use of standard Lapack and Blas libraries give an error due to the different sizes of object files. Something like

```
(xerbla.o): In function 'xerbla_': multiple definition of 'xerbla_'
/usr/lib/liblapack.a(xerbla.o): first defined here
/usr/bin/ld: Warning: size of symbol 'xerbla_' changed from 86
in /usr/lib/liblapack.a(xerbla.o) to 38
in /usr/lib/libblas.a(xerbla.o)
collect2: ld returned 1 exit status
```

This is a known bug and can be solved using the libraries provided with the Atlas packages and adding the corresponding path to the compilation: `-L /usr/lib/atlas`.

- 4 The order of the libraries is not irrelevant. In particular I found that `lapack` has to be invoked prior to `blas-3`.

6.3 Creating a Makefile to use cpp with gfortran

Added on November 09th, 2015.

There is a way of using the C language preprocessor, `cpp`, with `gfortran`. In this way we can communicate via Makefile with our program. Let's assume that we have a Fortran 90 program to compute two normally distributed set of random numbers that use the Box-Muller transform. The program is called `box_muller.f90` and we also compute the mean, median and standard variance of the resulting distributions using a subroutine called `stats.f90`¹. The FORTRAN 90 codes are provided in 'Fortran Codes' on this page.

The Makefile used for compilation is

```
# Fortran Compiler
FC=gfortran
#
# C Preprocessor
CPP=cpp
#
TYPE_DEF=-DPREC=DP
ifdef USE_SINGLE
TYPE_DEF = -DPREC=SP
endif
#
# Optimization Flags
OPTFLAGS = -O3 -funroll-loops -march=native
OPTFLAGS_P = "\"-O3 -funroll-loops -march=native\""
#
all: box_muller
#
.FORCE:
#
box_muller: box_muller.f90 stats.f90 .FORCE
$(CPP) -std=c89 $(TYPE_DEF) -D$(OPTFLAGS_P) $< > /tmp/$<
$(CPP) -std=c89 $(TYPE_DEF) stats.f90 > /tmp/stats.f90
$(FC) $(OPTFLAGS) -o $@ /tmp/stats.f90 /tmp/$<
rm /tmp/stats.f90 /tmp/$<
#
clean:
rm -f *.o box_muller
```

¹Please, note that the subroutine is not optimized and could take a long time for a large number of data due to an inefficient sort algorithm.

Note how `cpp` is called twice, once for each file and the `PREC` string are replaced either by `DP` or `SP`, the last case if the option `USE_SINGLE` is set. In the main program the string `FLAGS` is replaced by the contents of the variable `OPTFLAGS_P` to print the compilation flags used. Thus to run the program in single precision the user proceed as follows

```
$ make all USE_SINGLE=1
cpp -std=c89 -DPREC=SP -DFLAGS="\-O3 -funroll-loops -march=native\" box_muller.f90 > /tmp/box_muller.f90
cpp -std=c89 -DPREC=SP stats.f90 > /tmp/stats.f90
gfortran -O3 -funroll-loops -march=native -o box_muller /tmp/stats.f90 /tmp/box_muller.f90
rm /tmp/stats.f90 /tmp/box_muller.f90
$ ./box_muller
10000
Time Box Muller subroutine : 4.00000019E-03
MEAN = -7.31508713E-03
STANDARD DEVIATION = 0.995381057
MEDIAN IS = 1.01202750E-04
Time STATS subroutine 1: 0.100005999
MEAN = 2.96602229E-04
STANDARD DEVIATION = 0.999957144
MEDIAN IS = 1.29099786E-02
Time STATS subroutine 2: 0.100006007
KIND = SINGLE ; Optimization Flags: -O3 -funroll-loops -march=native
```

6.3.1 Fortran Codes

Main program: `box_muller.f90`

```
PROGRAM Box_Muller_Prog
!
IMPLICIT NONE
!
! Single and double precision kind parameters
INTEGER, PARAMETER :: SP = KIND(1.0)
INTEGER, PARAMETER :: DP = KIND(1.0D0)
!
INTEGER :: I, IERR
REAL(KIND = PREC), DIMENSION(:), ALLOCATABLE :: X, Y
REAL(KIND = PREC) :: M, SD, MEDIAN
REAL(KIND = SP) :: time_end, time_start
!
!
CHARACTER(LEN = 6) :: PRECISION
!
! interface block
INTERFACE
  SUBROUTINE STATS(VECTOR,N,MEAN,STD_DEV,MEDIAN)
    IMPLICIT NONE
    ! Single and double precision kind parameters
    INTEGER, PARAMETER :: SP = KIND(1.0)
    INTEGER, PARAMETER :: DP = KIND(1.0D0)
    INTEGER, INTENT(IN) :: N
    REAL(KIND = PREC), INTENT(IN), DIMENSION(:) :: VECTOR
    REAL(KIND = PREC), INTENT(OUT) :: MEAN
    REAL(KIND = PREC), INTENT(OUT) :: STD_DEV
    REAL(KIND = PREC), INTENT(OUT) :: MEDIAN
  END SUBROUTINE STATS
END INTERFACE
!
! Set Precision for output
IF (PREC == DP) THEN
  PRECISION = "DOUBLE"
ELSE
  PRECISION = "SINGLE"
ENDIF
!
! Input number of data
READ*, I
!
ALLOCATE(X(1:I), STAT = IERR)
IF (IERR /= 0) THEN
  PRINT*, "X allocation request denied."
  STOP
ENDIF
!
ALLOCATE(Y(1:I), STAT = IERR)
IF (IERR /= 0) THEN
  PRINT*, "Y allocation request denied."
  STOP
ENDIF
!
! Set time start
CALL CPU_TIME(time_start)
!
CALL BOX_MULLER(I)
!
! Set time end
```

```

CALL CPU_TIME(time_end)
!
!PRINT*, X
!PRINT*, Y
!
PRINT*, "Time Box Muller subroutine :", time_end - time_start
time_start = time_end
!
CALL STATS(X,I,M,SD,MEDIAN)
!
PRINT *, ' MEAN = ',M
PRINT *, ' STANDARD DEVIATION = ',SD
PRINT *, ' MEDIAN IS = ',MEDIAN
!
! Set time end
CALL CPU_TIME(time_end)
!
PRINT*, "Time STATS subroutine 1:", time_end - time_start
time_start = time_end
!
IF (ALLOCATED(X)) DEALLOCATE(X, STAT = IERR)
IF (IERR /= 0) THEN
    PRINT*, "X NON DEALLOCATED!"
    STOP
ENDIF
!
CALL STATS(Y,I,M,SD,MEDIAN)
!
!
PRINT *, ' MEAN = ',M
PRINT *, ' STANDARD DEVIATION = ',SD
PRINT *, ' MEDIAN IS = ',MEDIAN
!
! Set time end
CALL CPU_TIME(time_end)
!
PRINT*, "Time STATS subroutine 2:", time_end - time_start
time_start = time_end
!
IF (ALLOCATED(Y)) DEALLOCATE(Y, STAT = IERR)
IF (IERR /= 0) THEN
    PRINT*, "Y NON DEALLOCATED!"
    STOP
ENDIF
!
PRINT*, "KIND = ", PRECISION, " ; Optimization Flags: ", FLAGS
!
CONTAINS
!
SUBROUTINE BOX_MULLER(dim)
!
! Uses the Box-Muller method to create two normally distributed vectors
!
INTEGER, INTENT(IN) :: dim
!
REAL(KIND = PREC), PARAMETER :: PI = ACOS(-1.0)
REAL(KIND = PREC), DIMENSION(dim) :: RANDOM_u, RANDOM_v ! Automatic arrays
!
CALL RANDOM_NUMBER(RANDOM_u)
CALL RANDOM_NUMBER(RANDOM_v)
!
X = SQRT(-2.0_ PREC*LOG(RANDOM_u))
Y = X*SIN(2*PI*RANDOM_v)
X = X*COS(2*PI*RANDOM_v)
!
END SUBROUTINE BOX_MULLER
!
END PROGRAM Box_Muller_Prog

```

Subroutine: stats.f90

```

SUBROUTINE STATS(VECTOR,N,MEAN,STD_DEV,MEDIAN)
IMPLICIT NONE
! Single and double precision kind parameters
INTEGER, PARAMETER :: SP = KIND(1.0)
INTEGER, PARAMETER :: DP = KIND(1.0D0)
! Argument definition
INTEGER , INTENT(IN) :: N
REAL(KIND = PREC) , INTENT(IN) , DIMENSION(:) :: VECTOR
REAL(KIND = PREC) , INTENT(OUT) :: MEAN
REAL(KIND = PREC) , INTENT(OUT) :: STD_DEV
REAL(KIND = PREC) , INTENT(OUT) :: MEDIAN
! Local variables
REAL(KIND = PREC) :: VARIANCE = 0.0
REAL(KIND = PREC) :: SUMXI = 0.0, SUMXI2 = 0.0
REAL(KIND = PREC) , DIMENSION(1:N) :: Y
!
SUMXI=SUM(VECTOR)
SUMXI2=SUM(VECTOR*VECTOR)
MEAN=SUMXI/N

```

```

VARIANCE=(SUMXI2-SUMXI*SUMXI/N)/(N-1)
STD_DEV = SQRT (VARIANCE)
Y=VECTOR
! Sort values
CALL SELECTION
IF (MOD(N,2) == 0) THEN
  MEDIAN=(Y(N/2)+Y((N/2)+1))/2
ELSE
  MEDIAN=Y((N/2)+1)
ENDIF
CONTAINS
SUBROUTINE SELECTION
  IMPLICIT NONE
  INTEGER :: I,J,K
  REAL :: MINIMUM
  DO I=1,N-1
    K=I
    MINIMUM=Y(I)
    DO J=I+1,N
      IF (Y(J) < MINIMUM) THEN
        K=J
        MINIMUM=Y(K)
      END IF
    END DO
    Y(K)=Y(I)
    Y(I)=MINIMUM
  END DO
END SUBROUTINE SELECTION
END SUBROUTINE STATS

```

6.3.2 References

- 1 StackOverflow (<https://stackoverflow.com/questions/31649691/stringify-macro-with-gnu-gfortran/31753386#31753386>)

6.4 Obtaining environment variables values from Fortran

Created on March 9th, 2018

With the gfortran compiler the intrinsic procedure `GET_ENVIRONMENT_VARIABLE` allows the reading of environment variables such as `hostname`, `username`, or `.`. The syntax for this procedure is

```
CALL GET_ENVIRONMENT_VARIABLE(NAME[, VALUE, LENGTH, STATUS, TRIM_NAME])
```

This procedure replaces the now deprecated `GETENV` procedure. In the next program we use this subroutine to get values of the environment variables `HOSTNAME`, `USER`, and `HOME`. Note that unless the user has exported this variable `HOSTNAME` reading may fail. We also use the intrinsic procedure `GETPID` to obtain the process `PID` number.

```

PROGRAM GET_ENV
!
  IMPLICIT NONE
!
  INTEGER :: ivar = 0, len, stat, pid
  CHARACTER(LEN=256) :: home, host, user
!
! Hostname variable
  CALL GET_ENVIRONMENT_VARIABLE('HOSTNAME', host, len, stat)
  IF (stat == 0) THEN
    PRINT*, "Hostname read: ", TRIM(host)
  ELSE
    PRINT*, "Hostname read failed: stat = ", stat
  ENDIF
!
! Username variable
  CALL GET_ENVIRONMENT_VARIABLE('USER', user, len, stat)
  IF (stat == 0) print*, "Username read: ", TRIM(user)
!
! Homedir variable
  CALL GET_ENVIRONMENT_VARIABLE('HOME', home, len, stat)
  IF (stat == 0) THEN
    PRINT*, "Homedir read: ", TRIM(home)
  ELSE
    PRINT*, "Homedir read failed: stat = ", stat
  ENDIF
!
! Process ID
  pid = GETPID()
  PRINT*, "Process ID: ", pid
!
END PROGRAM GET_ENV

```


A possible output of the previous code is

```
$ ./get_env_gfortran
Hostname read failed: stat =          1
Username read: bilbo
Homedir read: /home/bilbo
Process ID:      5614
```

6.5 Creating a vector of random data

Created on March 8th, 2018

The best way to deal with random numbers with `gfortran` is making use of the intrinsic procedures `RANDOM_NUMBER` and `RANDOM_SEED`. Note that `RAN` and `RAND` procedures have been deprecated. From the `gfortran` documentation:

Returns a single pseudorandom number or an array of pseudorandom numbers from the uniform distribution over the range 0 \leq x

Therefore the creation of a vector with, e.g. 100 random integers in the 0–99 range should be accomplished with a simple program as this one

```
PROGRAM RANDOM_VECTOR
  IMPLICIT NONE
  REAL, DIMENSION(1:100) :: REAL_RAND_VALUES
  INTEGER, DIMENSION(1:100) :: INT_RAND_VALUES
  INTEGER :: INDEX
  !
  CALL RANDOM_NUMBER(REAL_RAND_VALUES)
  !
  INT_RAND_VALUES = NINT(REAL_RAND_VALUES*100)
  !
  DO INDEX = 1, 100
    PRINT*, INDEX, INT_RAND_VALUES(INDEX)
  ENDDO
  !
END PROGRAM RANDOM_VECTOR
```

And everything seems pretty okay until we run several times the program and observe that our random number vector always have the same values... Surprise...

```
      1      100
      2       57
      3       97
.....
     98       11
     99       22
    100       10
```

The problem is that `RANDOM_NUMBER` provides a sequence of pseudorandom values. If it starts the sequence from the same point, it gives you always the same sequence. We need to chose a different starting point every time that we use the procedure. This can be done using `RANDOM_SEED` and providing a particular value to this procedure, e.g. the process `PID`. This is done in the code that follows

```
PROGRAM RANDOM_VECTOR
  IMPLICIT NONE
  REAL, DIMENSION(1:100) :: REAL_RAND_VALUES
  INTEGER, DIMENSION(1:100) :: INT_RAND_VALUES
  INTEGER, DIMENSION(:), ALLOCATABLE :: pid
  INTEGER :: index, size=1
  !
  ! Get minimum size of the PUT array for RANDOM_SEED
  CALL RANDOM_SEED(SIZE=size)
  !
  ! Allocate and give values to pid array
  ALLOCATE(pid(1:size))
  pid = GETPID()
  !
  ! Restart random seed
  CALL RANDOM_SEED(PUT=pid)
  !
  ! Generate random vector
  CALL RANDOM_NUMBER(REAL_RAND_VALUES)
  !
  ! Transform to integers
  INT_RAND_VALUES = NINT(REAL_RAND_VALUES*100)
  !
  DO index = 1, 100
    PRINT*, index, INT_RAND_VALUES(index)
  ENDDO
  !
END PROGRAM RANDOM_VECTOR
```

6.6 Obtaining the values and positions of the larger values in an array

Created on July 30th, 2018

We use the random vector building method of ‘Creating a vector of random data’ on the previous page to build an array of random values and then show how to obtain the indexes and values of the largest elements in each row or column of the array. In order to do so we use the intrinsic procedures `MAXVAL` and `MAXLOC`.

Therefore we first create a two dimensional array with 100 random integers in the 0–1 range, display the array and then calculate the maximum values and its index in a column-wise and a row-wise way.

```
PROGRAM MAXIMA_VALUES_POSITIONS
  IMPLICIT NONE
  INTEGER, PARAMETER :: dim = 10
  REAL, DIMENSION(1:dim,1:dim) :: ARRAY_VALUES
  REAL, DIMENSION(1:dim) :: MAX_VALUES
  INTEGER, DIMENSION(1:dim) :: MAX_INDEX
  INTEGER, DIMENSION(:), ALLOCATABLE :: pid
  INTEGER :: index, size=1
  !
  ! Get minimum size of the PUT array for RANDOM_SEED
  CALL RANDOM_SEED(SIZE=size)
  !
  ! Allocate and give values to pid array
  ALLOCATE(pid(1:size))
  pid = GETPID()
  !
  ! Restart random seed
  CALL RANDOM_SEED(PUT=pid)
  !
  ! Generate random vector
  CALL RANDOM_NUMBER(ARRAY_VALUES)
  !
  ! Display array
  DO index = 1, dim
    PRINT 10, index, ARRAY_VALUES(index,:)
  ENDDO
  !
  !
  PRINT*
  !
  !
  PRINT*, 'MAXIMUM COLUMN-WISE VALUES'
  MAX_VALUES = MAXVAL(ARRAY_VALUES, 1)
  MAX_INDEX = MAXLOC(ARRAY_VALUES,1)
  DO index = 1, dim
    PRINT 20, index, MAX_INDEX(index), MAX_VALUES(index)
  ENDDO
  !
  PRINT*
  !
  PRINT*, 'MAXIMUM ROW-WISE VALUES'
  MAX_VALUES = MAXVAL(ARRAY_VALUES, 2)
  MAX_INDEX = MAXLOC(ARRAY_VALUES, 2)
  DO index = 1, dim
    PRINT 20, index, MAX_INDEX(index), MAX_VALUES(index)
  ENDDO
  !
  10 FORMAT(1X, I2, 1X, *(F6.4, 1X)) ! Note the * in the format statement for variable number of fields
  !
  20 FORMAT(2X, I2, 1X, I2, 2X, F6.4)
END PROGRAM MAXIMA_VALUES_POSITIONS
```

Notice that if the second argument to the procedures is one the array is sliced column-wise and if it is two it is sliced row wise. There are analogous procedures for minimum values with the intrinsics `MINVAL` and `MINLOC`.

6.7 Tips for building a Fortran Makefile

Created on March 20th, 2018

I enclose a template of a Fortran 90 Makefile that solves some common problems that appear when using the make application with this programming language. Let’s assume that we have a program file called `prog_main.f90` that depends on two module files, `module_a.f90` and `module_b.f90`. And we want to use the preprocessor and to build single thread and multithread execs making use of `openmp`. The template Makefile is as follows:

```
BINPATH = ../bin/
#####
prog_SRC = module_a.f90 module_b.f90 prog_main.f90
#
```

```

prog_OBJ = $(prog_SRC:.f90=.o)
#
prog_OPENMP_OBJ = $(prog_SRC:.f90=.oOMP)
#####
#
.SUFFIXES:
.SUFFIXES: .o .f90 .oOMP
###
FC = gfortran
FOPT = -O3 -Wall
PREP = -cpp
#
MODLIB = -I/usr/local/include/lapack95_modules
LAPACK95 = -L/usr/local/lib -llapack95
LAPACK77 = -llapack
BLAS = -lblas
#
LIBS = $(LAPACK95) $(LAPACK77) $(BLAS)
#####
all: prog prog_openmp
#####
.PHONY : all
#####
.f90.o:
$(info )
$(info Compiling single thread object file:)
$(FC) -c $(PREP) $(MODLIB) "$<"
#####
.f90.oOMP:
$(info )
$(info Compiling multi thread object file:)
$(FC) -c -fopenmp $(PREP) $(MODLIB) -o "$@" "$<"
#####
prog: $(prog_OBJ) Makefile
$(info )
$(info Linking prog single thread executable:)
$(FC) $(FOPT) $(MODLIB) -o $(BINPATH)/$@_$(FC) $(prog_OBJ) $(LIBS)
#####
prog_openmp: $(prog_OPENMP_OBJ) Makefile
$(info )
$(info Linking prog multithread executable:)
$(FC) -fopenmp $(FOPT) $(MODLIB) -o $(BINPATH)/$@_$(FC) $(prog_OPENMP_OBJ) $(LIBS)
#####
clean:
$(info Cleaning object, module, and executable files.)
@rm -f *.o *.oOMP *.mod $(BINPATH)/prog_$(FC) $(BINPATH)/prog_openmp_$(FC)
#####

```

Notice, for example, the empty `SUFFIXES` line, as it resets the predefined suffixes to avoid dependency problems associated with the `.mod` module files. The executable files are called `prog_gfortran` and `prog_openmp_gfortran` and are stored in the folder defined by the `BINPATH` variable.

Chapter 7

Python Tips and Templates

7.1 Creating a vector of random data

Created on April 12th, 2015.

The following snippet of Ipython code computes a vector, called *vectorn*, with 10 elements of normally distributed random data

```
import numpy as np

np.random.randn(10)
Out[2]:
array([-0.20490308, -0.39783301, -0.6802615 , -0.57939922, -0.10054472,
       -0.20376277, -1.48068811,  0.98628113, -0.79514919, -0.09896364])

vectorn = np.random.randn(200)
```

7.2 Logical comparison between two boolean vectors

Created on May 06th, 2015.

The following snippet of Ipython code defines two vector, called *vectorA* and *vectorB*, with 20 elements of normally distributed random data each and, using the NumPy function `logical_and` check the occurrences where the corresponding elements of the two vectors are larger than zero

```
import numpy as np

vectorA = np.random.randn(20)
vectorB = np.random.randn(20)

boolvec = np.logical_and(vectorA > 0, vectorB > 0)

vectorA[boolvec]
Out[47]: array([ 0.39058535,  1.0062992 ])
```

```
vectorB[boolvec]
Out[48]: array([ 0.87795544,  0.59063525])
```

7.3 Creating a loop iterating on a list and the list index

Created on April 16th, 2015.

The following snippet of Ipython code uses as a starting point a a vector, called *vn*, with 10 elements of uniformly distributed random data in the interval $[0,1]$ and in a loop, using as iterator a pair *index, value*, we build a symmetric matrix *A* such that $A_{ij} = v_{n_i} v_{n_j}$.

```
import numpy as np
##
vn = np.random.rand(20)
##
A_matrix = np.zeros((20,20))
##
for i, ival in enumerate(vn):
    for j, jval in enumerate(vn):
        A_matrix[i,j] = ival*jval
```

It can be easily optimized not computing the full matrix but the upper or lower diagonal and adding to its transpose (beware of double counting diagonal elements).

7.4 Adding a column to a Pandas dataframe

Created on April 21st, 2015.

If we have a Pandas dataframe for example, the following one, called `df0`

```
import numpy as np
import pandas as pd

vectorn = np.random.rand(20)
df0 = pd.DataFrame(data=vectorn, columns = ["s0"])
```

We can now add a second column of random data using the `pd.Series` command; the column is labeled `s1`

```
vectors = np.random.rand(20)
df0["s1"] = Series(data=vectors, index = index.df0)
```

7.5 Getting the maximum component of a vector and its index in numpy

Created on April 12th, 2015.

The following snippet of `ipython` code computes a vector, called *vectorn*, with 200 elements of uniformly distributed random data in the interval $[0,1]$.

```
import numpy as np

vectorn = np.random.rand(200)

max_val, max_index = vectorn.max(), vectorn.argmax()

max_val
Out[87]: 0.99652709220203461

max_index
Out[88]: 117
```

7.6 Some easy examples of offset-aware times with `pytz`

Created on May 13th, 2015.

Dealing with timezones and the associated DST (daylight saving times) can cause a more than serious headache. Here we have some (very limited) examples of their use.

Let's assume that we have two strings: `stdatet1 = "20/03/2015 12:22"` and `stdatet1 = "23/03/2015 22:22"` and we want to parse them to a `datetime` object. This is done as follows:

```
from dateutil.parser import parse
stdatet1 = "20/03/2015 12:22"
stdatet2 = "23/03/2015 22:22"

datet1 = parse(stdatet1, dayfirst=True)

date2 = parse(stdatet2, dayfirst=True)

datet1
Out[6]: datetime.datetime(2015, 3, 20, 12, 22)

date2
Out[7]: datetime.datetime(2015, 3, 23, 22, 22)

date2-datet1
Out[8]: datetime.timedelta(3, 36000)
```

At this point we have offset-naive times. If we want to transform to a given time zone, e.g. CET then we use

```
import pytz

cet_tz = pytz.timezone("CET")

cet_date1 = cet_tz.normalize(cet_tz.localize(date1))
cet_date2 = cet_tz.normalize(cet_tz.localize(date2))

cet_date1
Out[12]: datetime.datetime(2015, 3, 20, 12, 22, tzinfo=<DstTzInfo 'CET' CET+1:00:00 STD>)

cet_date2-cet_date1
Out[14]: datetime.timedelta(3, 36000)
```

We can now transform these time data to UTC

```
utc_tz = pytz.timezone('UTC')

utc_date1 = cet_date1.astimezone(utc_tz)
utc_date2 = cet_date2.astimezone(utc_tz)

utc_date2 - utc_date1
Out[22]: datetime.timedelta(3, 36000)
```

We can transform directly to UTC from the initially parsed variables

```
UTC_date1 = utc_tz.normalize(utc_tz.localize(date1))

UTC_date1
Out[28]: datetime.datetime(2015, 3, 20, 12, 22, tzinfo=<UTC>)

UTC_date1 - utc_date1
Out[27]: datetime.timedelta(0, 3600)
```

These functions can be applied on lists using lambda functions.

7.7 Creating a panel array of plots with Matplotlib

Created on April 12th, 2015.

The following snippet of code uses a vector of length 200 with random normally distributed data (see 'Creating a vector of random data' on page 71) and plot in four panels the data, their cumulative sum, a histogram with the data, and the sum of the data to a quadratic function.

```
import numpy as np
from matplotlib import pyplot

fig, axes = pyplot.subplots(2, 2) # Define plot of 2x2 panels

axes[0, 0].plot(vectorn, "k-o")
Out[36]: [<matplotlib.lines.Line2D at 0x7f827af2a510>]

axes[0, 1].plot(vectorn.cumsum(), "k--")
Out[37]: [<matplotlib.lines.Line2D at 0x7f827af2a1d0>]

axes[1, 0].hist(vectorn, bins=30, color="r", alpha=0.3)
Out[38]:
(array([ 3.,  0.,  2.,  2.,  4.,  2.,  6.,  4., 10., 12.,  8.,
        10., 13., 14., 16., 14.,  9., 10.,  9., 13.,  8.,  5.,
         8.,  3.,  5.,  6.,  0.,  1.,  1.,  2.]),
 array([-2.41379287, -2.24330459, -2.0728163 , -1.90232801, -1.73183972,
        -1.56135143, -1.39086315, -1.22037486, -1.04988657, -0.87939828,
        -0.70891 , -0.53842171, -0.36793342, -0.19744513, -0.02695684,
         0.14353144,  0.31401973,  0.48450802,  0.65499631,  0.8254846 ,
         0.99597288,  1.16646117,  1.33694946,  1.50743775,  1.67792603,
         1.84841432,  2.01890261,  2.1893909 ,  2.35987919,  2.53036747,
         2.70085576])),
 <a list of 30 Patch objects>)

axes[1, 1].scatter(np.arange(200), 0.01*np.arange(200)**2+10*vectorn)
Out[39]: <matplotlib.collections.PathCollection at 0x7f827aede90>

pyplot.show()
```

7.8 Creating a panel array of plots with common axes using Matplotlib

Created on April 12th, 2015.

The following snippet of code add different vectors of length 200 with random normally distributed data (see ‘Creating a vector of random data’ on page 71) to a parabollic function (mimicking experimental errors in a object free fall) and plot the results in four panels, with common abscysa and ordinate axes, and controlling the spacing between the panels.

```
import numpy as np
from matplotlib import pyplot

vectorn = np.random.randn(100)

result1 = 0.5*9.8*time_grid**2 + 2*vectorn
result2 = 0.5*9.8*time_grid**2 + 4*vectorn
result3 = 0.5*9.8*time_grid**2 + 8*vectorn
result4 = 0.5*9.8*time_grid**2 + 16*vectorn

fig, axes = pyplot.subplots(2,2,sharex=True,sharey=True)

axes[0,0].plot(result1,"k-o")
Out[85]: [<matplotlib.lines.Line2D at 0x7f827aa7ae10>]

axes[0,1].plot(result2,"k-o")
Out[86]: [<matplotlib.lines.Line2D at 0x7f827aa7ae90>]

axes[1,0].plot(result3,"k-o")
Out[87]: [<matplotlib.lines.Line2D at 0x7f827aa7a4d0>]

axes[1,1].plot(result4,"k-o")
Out[88]: [<matplotlib.lines.Line2D at 0x7f827aaaff10>]

pyplot.subplots_adjust(wspace=0,hspace=0)

pyplot.show()
```

7.9 Combining several plots in a figure

Created on June 10th, 2015.

The following snippet of Ipython code computes three vectors, called *vector1*, *vector2*, and *vector3*, with 100 elements of normally distributed random data with the same mean value (2) and different standard deviations (0.1, 0.2, and 0.4). We then plot the three vectors in a single graph controlling the line styles and labels and ticks font sizes.

```
import numpy as np

meanval = 2
vector1 = np.random.normal(loc = meanval, scale = 0.2, size = 100)
vector2 = np.random.normal(loc = meanval, scale = 0.4, size = 100)
vector3 = np.random.normal(loc = meanval, scale = 0.8, size = 100)

ax = pyplot.subplot(111)

ax.plot(vector1,"o--b",lw=3)
ax.plot(vector2,"x:r",lw=2)
ax.plot(vector3,"g",lw=2)

ax.set_xlabel(r'X axis Label (a.u.)',fontsize=16)
ax.set_ylabel(r'Y axis Label $v_1, v_2, v_3$',fontsize = 16)
pyplot.setp(ax.get_xticklabels(), fontsize=14)
pyplot.setp(ax.get_yticklabels(), fontsize=14)
```

7.10 Display in Ipython all the components of a Pandas Series or DataFrame

Created on January 29th, 2016.

Working in Ipython> only the head and tail of Series or DataFrames data structures are displayed. In order to display the full contents of DataFrames named e.g. `exp_vals_H2` the following commands can be used.

```
pd.set_option('display.max_rows', len(exp_vals_H2))
print(exp_vals_H2)
pd.reset_option('display.max_rows')
```

If this is repeatedly needed a function can be defined as follows

```
def print_full(x):
    pd.set_option('display.max_rows', len(x))
    print(x)
    pd.reset_option('display.max_rows')
```


7.10.1 References

- 1 Stack Exchange (<http://stackoverflow.com/questions/19124601/is-there-a-way-to-pretty-print-the>

7.11 Changing the number of lines to scroll in an Ipython qtconsole session.

Created on April 3rd, 2018.

Working in Ipython qtconsole the standard is that you can scroll up 500 lines. This number can be changed in some different ways (see references) but the simplest way may be in the program invocation. For example, to increase this number to 1000 lines one should execute:

```
ipython qtconsole --IPythonWidget.buffer_size=1000
```

7.11.1 References

- 1 Stack Exchange Ipython Qtconsole Buffer Limit (<https://stackoverflow.com/questions/14720766/how-to-increase-the-ipython-qtconsole-scrollbar-buffer-limit>)

Chapter 8

Text Processing and Formatting

Translations of this chapter:

You can find a translation into Ukranian (<http://www.katrinastillstanding.com/how-to-gnu-linux/>) by Kate Belevets of OhMyEssay.com (<https://ohmyessay.com/>).

You can find a translation to French by Maxwell Edward in this link (<https://fateknoloji.com/perez/>).

You can find a translation to Hindi by Mahesh Varma in this link (<https://dealsdaddy.co.uk/translations/textprocessingformatting/>).

8.1 pdftk application examples

Updated on April 18th, 2017.

Updated on December 1st, 2011.

We present several examples of transforming PDF files using the program `pdftk`, a powerful and simple application to work with PDF files.

- 1 Removing pages. If we have a file named `text.pdf` with ten pages, the following commands transform the file removing certain pages and saving the transformed output in file `out_text.pdf`:

- Remove first two pages:

```
$ pdftk text.pdf cat 3-10 output out_text.pdf
```

- Remove pages 2, 3, and 6:

```
$ pdftk text.pdf cat 1 4-5 7-10 output out_text.pdf
```

- Merge PDF files.

```
$ pdftk 1.pdf 2.pdf 3.pdf 4.pdf cat output file1234.pdf
```

This command merges four files into a final file `file1234.pdf`.

- Split the pdf file into pages. If you want to create a pdf including only the first page of file `jpcA.pdf`

```
pdftk jpcA.pdf cat 1 output jpcA_p1.pdf
```

In case you want to extract pages 1 to 3, leave out pages 4 and 5, and include the rest of the pages you can execute

```
pdftk jpcA.pdf cat 1-3 6-end output jpcA_partial.pdf
```

- If you want to extract all the pages of a pdf document in separate files you can use the `burst` option. If the file `document_A.pdf` has 8 pages the command

```
pdftk document_A.pdf burst output document_A_page_%01d.pdf
```

creates files `document_A_page_1.pdf ... document_A_page_8.pdf`.

- If you want to include a pdf file amid the pages of another pdf document, e.g. we want to include file `document_small.pdf` after page 8 of file `document_big.pdf` and save the final result into a file called `document.pdf`, we can do this as follows

```
pdftk A=document_big.pdf B=document_small.pdf cat A1-8 B A9-end output document.pdf
```

- (To Do) Decrypt input or encrypt output.
- (To Do) Generate FDF data stencil from PDF forms.
- (To do) Apply a background watermark or a foreground stamp.

8.2 Merge two PostScript or PDF files

Updated on December 1st, 2011.

We explain an alternative way to merge PDF files, to avoid using `pdftk`. This is also applicable to PostScript files.

You can also merge two PostScript or PDF files using `gs`

```
$gs -q -dNOPAUSE -dBATCH -sDEVICE=pswrite \
-sOutputFile=bla.ps -f foo1.ps foo2.ps

$gs -q -dNOPAUSE -dBATCH -sDEVICE=pdfwrite \
-sOutputFile=bla.pdf -f foo1.pdf foo2.pdf
```

8.2.1 References

- 1 Debian Reference Guide (<http://qref.sourceforge.net/Debian/reference/ch-tips.en.html#s8.6.24>)

8.3 Include *et al.* in `bibtex`

You can include the term *et al.* to replace a long set of authors in a `bibtex` reference using `and others`. Thus, if you want to include only the first two authors and replace the rest by others, the `bibtex` author field should be written as

```
author = {First Author and Second Author and others},
```

8.4 Include bibliographical info in each chapter using LaTeX

You can include the bibliography after each chapter in LaTeX using the package `chapterbib`. You can even change the citation style for each chapter. In order to do so include at the beginning of the main `tex` source file the line

```
\usepackage{chapterbib}
```

Then at the end of each chapter include

```
\bibliographystyle{alpha}
\bibliography{texfilename}
```

For each chapter you can change the bibliography style if necessary. If you are using `\include{filename}` do not forget to run `bibtex` to each of the included files possessing a bibliography entry.

8.5 Comment paragraphs in LaTeX

In order to comment one or several paragraphs in a LaTeX source file instead of making use of the % character you can use the `verbatim` package including at the beginning of your `tex` file

```
\usepackage{verbatim}
```

And then you can simply comment several lines of the file making use of `\begin{comment}` and `\end{comment}`

```
\begin{comment}
Commented fragment ...
\end{comment}
```

8.6 Installing appropriately a LaTeX package or style.

The way to install a LaTeX package in the right path is shown. The first step is to look for the place where the package should be installed.

```
$ kpsewhich -expand-var "$TEXMFLOCAL"
/usr/local/share/texmf
```

Unpack the latex package that is going to be installed and copy the directories (`bibtex/`, `doc/`, `tex/` ...) to the previous path, `/usr/local/share/texmf` and rehash the database.

```
$ sudo cp -r doc tex source bibtex /usr/local/share/texmf
$ texhash
texhash: Updating /usr/local/share/texmf/ls-R...
texhash: Updating /var/lib/texmf/ls-R-TEXMFMAIN...
texhash: Updating /var/lib/texmf/ls-R-TEXLIVE...
texhash: Updating /var/lib/texmf/ls-R...
texhash: Done.
```

The style is now ready and installed.

8.7 Change the selected language in DebianDoc files

In order to change the selected language for a DebianDoc `sgml` file the option `-l` is employed. This affects the different tags and labels in the text.

For example, assuming that the default language in the system is English and we want to generate a version in Spanish in ASCII format of the file `test.sgml` we should employ

```
debiandoc2text -les_ES test.sgml
```

In this case we suppose that the locale `es_ES` is available¹.

8.8 Avoid Page %d may be too complex to print errors.

When preparing pdf files from LaTeX files sometimes the `dvipdf` script takes a very long time to complete the pdf file and outputs some errors like in the following example.

```
$ dvipdf test.dvi
Page 1 may be too complex to print
Page 3 may be too complex to print
Warning: no %%Page comments generated.
```

¹You can check the available locales in the file `/etc/locale.gen`.

Moreover, when the final pdf file is opened with a viewer there is a long series of error messages

```
$ xpdf test.pdf
Error: Bad bounding box in Type 3 glyph
Error: Bad bounding box in Type 3 glyph
Error: Bad bounding box in Type 3 glyph
Error: Bad bounding box in Type 3 glyph
Error: Bad bounding box in Type 3 glyph
Error: Bad bounding box in Type 3 glyph
```

This is due to the inclusion of the command `\usepackage[T1]{fontenc}` in the input file. This is convenient when writing in Spanish because in this way you have access to special characters (as accented letter).

The solution to the problem consists in making use of the `latin-modern` fonts. The heading of the tex file should include

```
\usepackage[T1]{fontenc}
\usepackage{lmodern}
```

The Debian package that includes this fonts should be installed and its name is `lmodern.deb`.

8.9 Diverse LaTeX lists

LaTeX distinguishes between three different list environments: `enumerate`, `itemize`, and `description`. Each environment provides four levels, which implies you can have nested lists of up to four levels. The description of the three environments is the following.

1 *Enumerate*

The syntax in this case is

```
\begin{enumerate}
\item ...
\end{enumerate}
```

The `enumerate` environment permits the definition of numbered lists. If you like to change the appearance of the enumerator, the simplest way to change is to use the `enumerate-package`, giving you the possibility to optionally choose an enumerator.

```
\usepackage{enumerate}
...
\begin{enumerate}[I]%for capital roman numbers.
\item
\end{enumerate}

\begin{enumerate}[(a)]%for small alpha-characters within brackets.
\item
\end{enumerate}
```

2 *Itemize*

Itemization is probably the mostly used list in LaTeX. It also provides four levels.

```
\begin{itemize}
\item ...
\end{itemize}
```

The bullets marking each item can be changed for each level using the following command:

```
\renewcommand{\labelitemi}{$\bullet$}
\renewcommand{\labelitemii}{$\cdots$}
\renewcommand{\labelitemiii}{$\diamond$}
\renewcommand{\labelitemiv}{$\ast$}
```

Amongst the more commonly used symbols are `$$\bullet$`, `$$\cdots$`, `$$\diamond$`, `$$-$`, `$$\ast$`, and `$$\circ$`.

3 *Description*

The description list is very handy if you need to explain notations or terms. Its neither numbered nor bulleted. The user can define the string marking each item.

```
\begin{description}
\item[] ...
\end{description}
```

In the three environments the space between different items can be controlled with the `\itemsep` command that can only be added just after `begin`

```
\begin{itemize}\itemsep2pt
\item
\end{itemize}
```

8.9.1 References

- 1 LaTeX Lists Environments (<http://texblog.wordpress.com/2008/10/16/lists-enumerate-itemize-description>)

8.10 Use Unicode encoding in LaTeX

In order to use `utf` encoding in LaTeX the following line should be added to the tex file

```
\usepackage[utf8]{inputenc}
```

If this option does not work use `utf8x` instead `utf8`.

8.11 Use color in LaTeX

Added on November 30th, 2011.

In order to use colors in your LaTeX the following line should be added to the file preamble

```
\usepackage{color}
```

The text can be colored in different ways

```
\textcolor{declared-color}{text}
{black text\color{declared-color} text}
```

where `declared-color` is a color that was defined before by `\definecolor`. You can change the background color of the whole page by:

```
\pagecolor{declared-color}
```

8.11.1 References

- 1 LaTeX Color in LaTeX Wiki Book (http://en.wikibooks.org/wiki/LaTeX/Colors#Adding_the_color_package)

8.12 Easy way of defining smaller margins in LaTeX

Added on January 20th, 2012.

Updated on February 1st, 2012

In order to define a LaTeX document with smaller margins than the default without tampering too much with measures and sizes the `fullpage` package can be used adding the your document header

```
\usepackage[options]{fullpage}
```

Possible options for this package are

- 1 in: (*default*) margins set to 1 in.
- 2 cm: margins set to 1.5 cm.
- 3 plain: (*default*) selects plain page style.
- 4 empty: neither headers nor footers.
- 5 headings: both headers and footers.
- 6 myheadings: both headers and footers.

```
\usepackage[cm]{fullpage}
```

With A4 papersize another possibility is

```
\usepackage{a4wide}
```

8.13 Changing footnote symbols in LaTeX

Added on January 8th, 2016.

The standard footnote symbol in a LaTeX text are numbers, and sometimes, when combined with equations, can produce certain ambiguity. The symbols can be changed to a set of rotating nine different symbols adding to the text preamble

```
\renewcommand{\thefootnote}{\fnsymbol{footnote}}
```

Another option is to change to alphabetic uppercase labels with the command

```
\renewcommand{\thefootnote}{\Alph{footnote}}
```

8.14 Using the same footnote mark in LaTeX

Added on February 5th, 2012.

Sometimes in LaTeX it is necessary to make reference to the same footnote several times in a page. The following syntax allows for this

```
Text that has a footnote\footnote{This is the footnote} looks like this. Later text referring to same footnote\footnotemark[\value{footnote}]
```

It is important to take into account that this doesn't work if there are other footnotes between the first reference and any of the other *duplicates*.

8.14.1 References

- 1 LaTeX wikibooks (<http://en.wikibooks.org/wiki/LaTeX/Formatting#Footnotes>)

8.15 Using the euro symbol in LaTeX

Added on February 7th, 2012.

The euro currency symbol in LaTeX is added making use of the package `eurosym`, which is part of all the major GNU/Linux distributions. The package has to be loaded in the document header

```
\usepackage{eurosym}
```

Then there are two possible ways of including the euro currency symbol.

```
The book is 10 \euro.  
The book is \euro 10.  
The book is \EUR{10}.  
\textbf{The book is \EUR{10}.}  
\textit{The book is \EUR{10}.}
```

8.16 Changing pages to landscape orientation in LaTeX texts

Added on November 16th, 2012.

The occurrence of a large table or figure in LaTeX sometimes hamper the display in the default portrait orientation. This can be solved changing one or various pages to landscape orientation.

The `geometry` package allows to change the full document to landscape orientation adding to the document header

```
\usepackage[landscape]{geometry}
```

The `lscape` package allows to change to landscape orientation a section of the document. To do so add the following line to the document header

```
\usepackage{lscape}
```

And whenever it is needed to switch to landscape orientation, e.g. to include a large table or figure the region affected by the change is defined as

```
\begin{landscape}  
... table or figure here ...  
\end{landscape}
```

This is specially suited for printing. To change also the orientation in the pdf file and for better screen readability use the package `pdfscape` in the header instead of `lscape`

```
\usepackage{pdfscape}
```

And proceed as before

```
\begin{landscape}  
... table or figure here ...  
\end{landscape}
```

8.16.1 References

- 1 Landscape in LaTeX (<http://texblog.org/2007/11/10/landscape-in-latex>)

8.17 Including single column figures or tables in a double column LaTeX document

Added on November 18th, 2012.

Sometimes when writing a two-column document the occurrence of a large table or figure in LaTeX forces its display in a single-column way. This can be solved for figures and tables using the `–*` variant

```
\begin{table*}

\end{table*}
\begin{figure*}

\end{figure*}
```

In this way figures and tables will occupy the full page.

8.18 Controlling horizontal spacing in LaTeX

Added on January 15th, 2016.

The horizontal spacing between words and between words and objects in LaTeX is automatically determined. However we may be interested in adding or removing space. This can be done making use of the command

```
\hspace{length}
```

Where `length` can be expressed in `cm`, `px`, etc. If such a space should be kept even if it falls at the end or the start of a line, use the command `\hspace*`.

The command

```
\stretch{n}
```

acts differently, generating “elastic” spacing. It extends until all the remaining space on a line is occupied. If two `\hspace{\stretch{n}}` commands are issued on the same line, they grow according to the stretch factor.

```
X\hspace{\stretch{1}}
X\hspace{\stretch{2}} X
```

```
x      x      x
```

8.18.1 References

- 1 Horizontal Space LaTeX WikiBooks (http://en.wikibooks.org/wiki/LaTeX/Formatting#Horizontal_Space)

8.19 Including BibTeX References in the TeX source file

Added on July 2nd, 2019.

Once you successfully compile your LaTeX source, including external references with `bibtex` from a bibfile you can include the references into the LaTeX source following two steps.

First, remove the line in your `tex` file defining the bibliography, e.g. `\bibliography{xxx}`, and then insert in the file the contents of the `bb1` file previously generated. Remove then the existing `aux` file and recompile.

8.20 Including comments and footnotes in the References section

Created on January 2nd, 2019.

The inclusion of footnotes and remarks in the reference list is provided by the package `notes2bib`. To load the package, include a line `\usepackage{notes2bib}` in the text head. Then any footnote content or relevant note can be deal with the command `\bibnote` as follows

```
There are two variables,  $a$  and  $b$ \bibnote[]{}{The  $b$  variable is  
related to the quantum number  $c$  as  $b = 2c$ .} and two control parameters: A and B.
```

Note that if you do not include the empty squared braces option in `\bibnote` a label to your comment will be added in addition to the reference keynote.

8.20.1 References

1 `notes2bib` documentation (<http://mirror.hmc.edu/ctan/macros/latex/contrib/notes2bib/notes2bib.pdf>)

Chapter 9

Graphic Edition

9.1 Include greek characters in inkscape

Find the unicode number corresponding to the greek character you want to include. Tables of codes can be found in Unicode Charts (<http://unicode.org/charts/PDF/U0370.pdf>). For example, the unicode for the alpha symbol is 03b1.

In a text cell type `Ctrl-u`, include the unicode key of the greek letter and press enter.

9.2 Include greek characters in Gimp

Find the unicode number corresponding to the Greek character you want to include. Tables of codes can be found in Unicode Charts (<http://unicode.org/charts/PDF/U0370.pdf>). For example, the unicode for the alpha symbol is 03b1.

In a text cell type `Ctrl-Shift-u`, include the unicode key of the Greek letter and press enter.

9.3 Change the text baseline in inkscape

In order to include sub and super-indexes in inkscape you can change the text base line in a text cell using the keys: `Alt-Up` and `Alt-Down`.

9.4 Use ImageMagick to transform graphic files

Updated on July 06th, 2014; September 22nd, 2016.

You can easily transform a graphic file from the console using the tool `convert` from the ImageMagick suite. Imagine for example that we start with the file `foto_0.png`.

```
$ identify foto_0.png
foto_0.png PNG 1209x1710 1209x1710+0+0 DirectClass 8-bit 2.63038mb
```

We have made use of the command `identify`, that is also part of the ImageMagick suite and describes the format and characteristics of image files. There are several ways to resize the file. The common syntax is `convert -resize geometry`. From the many possible ways of expressing the geometry change we present three useful options:

- 1 *scale%*: Height and width scaled by the specified percentage *scale*.
- 2 *width*: Width fixed to *width* and height automatically rescaled to conserve aspect ratio.
- 3 *xheight*: Height fixed to *height* and width automatically rescaled to conserve aspect ratio.

We present examples of the three possibilities¹:

```
$ identify foto_0.png
foto_0.png PNG 1209x1710 1209x1710+0+0 DirectClass 8-bit 2.63038mb
$ convert -depth 8 -resize 50% foto_0.png foto_1.png
$ identify foto_1.png
foto_1.png PNG 605x855 605x855+0+0 DirectClass 8-bit 681.391kb
$ convert -depth 8 -resize 1024 foto_0.png foto_2.png
$ identify foto_2.png
foto_2.png PNG 1024x1448 1024x1448+0+0 DirectClass 8-bit 1.82886mb
$ convert -depth 8 -resize x800 foto_0.png foto_3.png
$ identify foto_3.png
foto_3.png PNG 566x800 566x800+0+0 DirectClass 8-bit 601.271kb
```

Apart from resizing images we can also transform from an image format to a different one. For example, to convert from encapsulated postscript (eps) to png format:

```
$ identify bsplot_N40.eps
bsplot_N40.eps PS 613x661 613x661+0+0 16-bit DirectClass 20.4KB 0.000u 0:00.000
$ convert bsplot_N40.eps bsplot.png
$ identify bsplot.png
bsplot.png PNG 613x661 613x661+0+0 8-bit PseudoClass 6c 8.64KB 0.000u 0:00.000
```

Convert can be also used to stack horizontally or vertically several images. For example, the command

```
$ convert Glacial_Map_0.jpg Glacial_Map_1.jpg Glacial_Map_2.jpg +append test.png
```

will produce a file `test.png` that includes the three figures appended in a row. To append them vertically the option is `-append`.

9.4.1 References

- 1 Linux Journal, issue 185, Sept. 2009 (<http://www.linuxjournal.com/article/10531>)

9.5 Enhancing colors and resolution in Gimp

A Gimp filter that improves and sharpen lines when colors are too weak can be found in

```
Filters -> Enhance -> Unsharp Mask
```

9.6 Remove the background of an image in Gimp

In order to remove the background of an image using Gimp a possible (easy) recipe is the following-

- 1 Using the *lasso* tool (also known as *Free Select Tool*) make a rough selection around the image that you want to remove the background from.
- 2 Activate the quick mask tool by selecting the little square at the bottom left side of the main image window. Using this tool the selection can be refined.
- 3 Using the pencil tool shade the background more precisely around your image. If you make a mistake you can either use `Ctrl Z` to undo your last action or change the pencil to white which will remove the mask.
- 4 Toggle the quick mask off, copy the image, and paste as new. This will result in a background-free copy of your image.
- 5 To refine the final result, add alpha to the selection (from the layers tool). Then, from the *Select* menu: (a) invert the selection, (b) feather the selection by 1 or 2 pixels, (c) `Ctrl + k` to clear, and (d) `Ctrl + Shift + A` to unselect.
- 6 Save your image.

¹Note that we added the option `-depth 8` to avoid the image depth to be changed to 16, the default system value.

9.7 Take a screenshot using Gimp

In order to take a screenshot of the full display, a window, or part of a window launch Gimp and select

```
File -> Create -> ScreenShot...
```

It is convenient to fix a time delay to be able to select the right window to grab the region of interest.

9.8 Change the color of markers in inkscape

Added on July 06th, 2014.

In order to change the color of markers (e.g. arrows end and start) in *inkscape* to coincide with the color of the stroke of the object they belong to the following effect should be enabled.

Extensions > Modify Path > Color Markers to Match Stroke

If

9.8.1 References

- 1 Inkscape FAQ (http://wiki.inkscape.org/wiki/index.php/Frequently_asked_questions#How_do_I_change_the_color_of_markers_.28e.g._arrow_ends.29.3F)

9.9 Modify the canvas size of a Gimp file

Added on November 10th, 2018

The *canvas* is the visible area of the Gimp image. By default the canvas and layers size coincides. The Canvas Size command lets you enlarge or reduce the canvas size. You can also modify the size of the layers. You can access this command from the image menubar through Image -- Canvas Size.

When you enlarge the canvas, you create free space around the contents of the image. When you reduce it, the visible area is cropped, however the layers still extend beyond the canvas border.

When you reduce the canvas size, the new canvas appears surrounded with a thin negative border in the preview. The mouse pointer is a moving cross: click and drag to move the image against this frame.

9.10 Terminal app to extract images from a pdf file

Added on October 24th, 2017.

If you need to extract images from a pdf file a convenient terminal application is *pdfimages*. For example if we need to extract the images from a file named *article.pdf* you can proceed as follows

```
$ pdfimages -all article.pdf ./article_images
$ ls
article.pdf  article_images-003.tif  article_images-006.tif
article_images-000.tif  article_images-004.pbm  article_images-007.tif
article_images-001.tif  article_images-004.png
article_images-002.tif  article_images-005.tif
```

The article contains seven images. The options *-all* indicate that JPEG, JPEG2000, JBIG2, and CCITT images are extracted in their native format while CMYK files are written as TIFF files and all other images are written as PNG files.

9.10.1 References

- 1 Howto Geek 228796 (<https://www.howtogeek.com/228796/how-to-extract-and-save-images-from-a-pdf/>)

Chapter 10

Miscelanea

10.1 Compute the average from the results of Moodle test grading

The starting point is a set of txt files with the grading obtained by students in Moodle. This set should include all students, not only the students that have participated in the test. The format of these files¹ is like the one in the following example

```
XXX XXXXXX XX 29 de January de 2009, 11:27 17 minutos 40 segundos 7
```

For those students that did not participate in the test, the format is the following

```
XXX XXXXXX XX - - -
```

The name of the files with the results are *test_i.txt* with $i = 1, 2, 3$. The number of files is not limited in principle. The following perl oneliner extract the required info, computes the average students' grade, and save the output in a CSV file format

```
perl -e 'while (<>) {
  $v{$1}+=$2 if (/^(.*)\b\s+\d+\s+de.*s\s+(\d+).*$/);
  $v{$1}+=0 if (/^(.*)\b\s+-\s+-\s+-.*$/);};
  foreach (sort keys(%v)) { print "$_ "; $v{$_}/3, "\n"}' \
  test_1.txt test_2.txt test_3.txt > grades.csv
```

10.2 Splitting in two lines a cell content in Openoffice/simpres

From OpenOffice Calc's help pages

Writing multi-line text:

- 1 The Ctrl+Enter key combination inserts a manual line break. This shortcut only works directly in the cell, not in the input line.
- 2 If you want the text to automatically break at the right border of the cell, proceed as follows: select all the cells where you want the text to break at the right border, and in Format - Cells - Alignment, mark the Automatic line break option and click OK.

10.3 Solving BADSIG errors in UBUNTU (Oneiric Ocelot)

Added on January 18th, 2012.

In Oneiric Ocelot, for reasons unknown to me, errors concerning the signature key plague the software update process. For example, the output obtained updating with apt-get with this problem is

¹The Moodle output is formatted using UTF-8, thus it may be necessary to convert, using emacs, to latin-1 formatting.

```
$ sudo apt-get update
Ign http://archive.canonical.com oneiric/partner Translation-en_US
Ign http://extras.ubuntu.com oneiric/main Translation-en
Hit http://sunsite.rediris.es oneiric-updates Release
Ign http://archive.canonical.com oneiric/partner Translation-en
Hit http://sunsite.rediris.es oneiric-backports Release
Hit http://sunsite.rediris.es oneiric-security Release
Ign http://sunsite.rediris.es oneiric-security Release
Hit http://sunsite.rediris.es oneiric/main Sources
Hit http://sunsite.rediris.es oneiric/restricted Sources
Hit http://sunsite.rediris.es oneiric/universe Sources
Hit http://sunsite.rediris.es oneiric/multiverse Sources
Hit http://sunsite.rediris.es oneiric/main i386 Packages
Hit http://sunsite.rediris.es oneiric/restricted i386 Packages
Hit http://sunsite.rediris.es oneiric/universe i386 Packages
Hit http://sunsite.rediris.es oneiric/multiverse i386 Packages
Hit http://sunsite.rediris.es oneiric/main TranslationIndex
Hit http://sunsite.rediris.es oneiric/multiverse TranslationIndex
Hit http://sunsite.rediris.es oneiric/restricted TranslationIndex
Hit http://sunsite.rediris.es oneiric/universe TranslationIndex
Hit http://sunsite.rediris.es oneiric-updates/main Sources
Hit http://sunsite.rediris.es oneiric-updates/restricted Sources
Hit http://sunsite.rediris.es oneiric-updates/universe Sources
Hit http://sunsite.rediris.es oneiric-updates/multiverse Sources
Hit http://sunsite.rediris.es oneiric-updates/main i386 Packages
Hit http://sunsite.rediris.es oneiric-updates/restricted i386 Packages
Get:2 http://sunsite.rediris.es oneiric-updates/universe i386 Packages [82.3 kB]
99% [2 Packages bzip2 0 B] [Waiting for headers] [Waiting for headers]
bzip2: Data integrity error when decompressing.
    Input file = (stdin), output file = (stdout)

It is possible that the compressed file(s) have become corrupted.
You can use the -tvv option to test integrity of such files.

You can use the 'bzip2recover' program to attempt to recover
data from undamaged sections of corrupted files.

Get:3 http://sunsite.rediris.es oneiric-updates/multiverse i386 Packages [4,976 B]
```

In order to fix this error follow the instructions below. *Notice that this implies moving directories and removing recursively as superuser. Be extremely cautious...*

In first place you open an interactive session as superuser and download the public key from the Ubuntu key server.

```
$ sudo -i
# apt-key adv --recv-key --keyserver keyserver.ubuntu.com 40976EAF437D05B5
```

Then proceed to make a backup copy of some directories and remove part of the stored info (remember, do not take the name of root in vain...)

```
# cp -arf /var/lib/dpkg /var/lib/dpkg.backup
# cp /var/lib/dpkg/status-old /var/lib/dpkg/status
# cp /var/lib/dpkg/available-old /var/lib/dpkg/available
# rm -rf /var/lib/dpkg/updates/*
# rm -rf /var/lib/apt/lists
```

Create the lists/partial directory, clean the cache and update again.

```
# mkdir -p /var/lib/apt/lists/partial
# apt-get clean
# apt-get update
```

This should be enough to fix the BADSIG problem. Hopefully.

Chapter 11

Translations of this document

The present document has been translated from (not-so-good) English to other languages:

- 1 Translation to Spanish of Chapter 3 (Perl Language) by MarÃa Ramos. (<http://www.webhostinghub.com/support/es/misc/instalacion-de-perl>)
- 2 Translation to Frech of the full document by Kate Bondareva. (<http://www.autoteiledirekt.de/science/certains-mini-howtos-dinteret>)