

# **Linux From Scratch**

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# Linux From Scratch

**Gerard Beekmans**

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This book describes the process of creating your own Linux system from scratch from an already installed Linux distribution, using nothing but the sources of software that are needed.

This book may be distributed only subject to the terms and conditions set forth in the LDP License at <http://www.linuxdoc.org/COPYRIGHT.html>

It is not necessary to display the license notice, as described in the LDP License, when only a small part of this book is quoted for informational or similar purposes. However, I do require you to display with the quotation(s) a line similar to the following line: "Quoted from the LFS-BOOK at <http://www.linuxfromscratch.org>"

---

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# Dedication

This book is dedicated to my loving and supportive wife *Beverly Beekmans*.

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---

# Preface

# Who would want to read this book

This book is intended for Linux users who want to learn more about the inner workings of Linux and how the various pieces of the Operating System fit together. This book will guide you step-by-step in creating your own custom build Linux system from scratch, using nothing but the sources of software that are needed.

This book is also intended for Linux users who want to get away from the existing commercial and free distributions that are often too bloated. Using existing distributions also forces you to use the file system structure, boot script structure, etc. that they choose to use. With this book you can create your own structures and methods in exactly the way you like them (which can be based on the ones this book provides)

Also, if you have security concerns, you don't want to rely on pre-compiled packages. So instead, you want to compile all programs from scratch and install them yourself. That could be another reason why you would want to build a custom made Linux system.

Those are just a few out of many reasons why people want to build their own Linux system. If you're one of those people, this book is meant for you.

---

# Who would not want to read this book

Users who don't want to build an entire Linux system from scratch probably don't want to read this book. If you, however, do want to learn more about what happens behind the scenes, in particular what happens between turning on your computer and seeing the command prompt, you want to read the "From Power Up To Bash Prompt" (P2B) HOWTO. This HOWTO builds a bare system, in a similar way as this book does, but it focusses more on just installing a bootable system instead of a complete system.

To decide whether you want to read this book or the P2B HOWTO, you could ask yourself this question: Is my main objective to get a working Linux system that I'm going to build myself and along the way learn and learn what every component of a system is for, or is just the learning part your main objective. If you want to build and learn, read this book. If you just want to learn, then the P2B HOWTO is probably better material to read.

The "From Power Up To Bash Prompt" HOWTO can be downloaded from <http://learning.taslug.org.au/power2bash>

---

# Organization

This book is divided into the following parts. Although there is a lot of duplicate information in certain parts, it's the easiest way to read it and not to mention the easiest way for me to maintain the book.

---

## Part I – Introduction

Part One gives you general information about this book (versions, where to get it, changelog, mailinglists and how to get in touch with me). It also explains a few important aspects you really want and need to read before you start building an LFS system.

---

## Part II – Installation of the LFS system

Part Two guides you through the installation of the LFS system which will be the foundation for the rest of the system. Whatever you choose to do with your brand new LFS system, it will be built on the foundation that's installed in this part.

---

## Part III – Appendixes

Part Three contains various Appendixes.

# I. Part I – Introduction

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# Chapter 1. Introduction

# Introduction

Having used a number of different Linux distributions, I was never fully satisfied with any of those. I didn't like the way the bootscripts were arranged, or I didn't like the way certain programs were configured by default and more of those things. I came to realize that when I want to be totally satisfied with a Linux system, I have to build my own Linux system from scratch, ideally only using the source code. Not using pre-compiled packages of any kind. No help from some sort of cdrom or bootdisk that would install some basic utilities. You would use your current Linux system and use that one to build your own.

This, at one time, wild idea seemed very difficult and at times almost impossible. The reason for most problems were due to my lack of knowledge about certain programs and procedures. After sorting out all kinds of dependency problems, compilation problems, etcetera, a custom built Linux system was created and fully operational. I called this system an LFS system, which stands for LinuxFromScratch.

---

# How things are going to be done

We are going to build the LFS system using an already installed Linux distribution such as Debian, SuSe, Slackware, Mandrake, RedHat, etc. You don't need to have any kind of bootdisk. We will use an existing Linux system as the base (since we need a compiler, linker, text editor and other tools).

If you don't have Linux installed yet, you won't be able to put this book to use right away. I suggest you first install a Linux distribution. It really doesn't matter which one you install. It also doesn't need to be the latest version, though it shouldn't be a too old one. If it is about a year old or newer it should do just fine. You will safe yourself a lot of trouble if your normal system uses glibc-2.0 or newer. Libc5 isn't supported by this book, though it isn't impossible to use a libc5 system if you have no choice.

---

# Book versions

This is the 2.4 stable version dated August 28th, 2000. If this version is older than a month you definitely want to take a look at our website and download a newer version.

- Columbus, Ohio, United States – <http://www.linuxfromscratch.org/index2.html>
  - United States – <http://lfs.sourceforge.net/index2.html>
  - Braunschweig, Niedersachsen, Germany – <http://134.169.139.209/index2.html>
  - Brisbane, Queensland, Australia – <http://lfs.mirror.aarnet.edu.au/index2.html>
  - France – <http://www.linuxien.com/lfs/index2.html>
-

# Acknowledgements

I would like to thank the following people and organizations for their contributions towards the LinuxFromScratch project:

- [Paul Jensen](http://www.pcrdallas.com) for providing <http://www.pcrdallas.com> as the main linuxfromscratch.org host
  - [Bryan Dumm](http://www.bcpub.com) for providing <http://www.bcpub.com> as the lfs.bcpub.com mirror
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  - [VA Linux Systems](#) who, on behalf of [Linux.com](http://www.linux.com), donated a VA Linux 420 (formerly StartX SP2) workstation towards this project
  - [Jesse Tie Ten Quee](#) who donated a Yamaha CDRW 8824E CD-RW.
  - [O'Reilly](#) who donated books on SQL and PHP.
  - Countless other people from the various LFS mailinglists who are making this book happen by making suggestions, testing and submitting bug reports.
-

# Changelog

If, for example, a change is listed for chapter 5 it (usually) means the same change has been done in the chapters for the other architectures.

2.4 – August 28th, 2000

- Split the book up into two different books for Intel and PPC.
- Chapter 4: Added the mail and dev/pts directories to the "Creating directories" section.
- Chapter 5: Everything from chroot and after has been put in a new chapter.
- Chapter 6: Moved the optimization part to the point just before you enter the chroot'ed environment. It's a waste to use compiler optimizations for the static packages since they will be replaced anyways.
- Chapter 6: To enter chroot we first cd to the \$LFS/root directory. Some older chroot programs have problems when you enter chroot when your starting directory isn't inside the chroot environment. Also we don't execute bash directly in the chroot'ed environment, but we start the "env" program so we can enter with a clean environment that only has CFLAGS and CXXFLAGS set.
- Chapter 6: A few people have had problems compiling M4 in the chroot'ed environment. Instructions are provided how to install this package statically for the affected users.
- Chapter 6: We can't move the 'mv' program during the dynamic installation of the fileutils package with the mv program. So we copy it to /bin first, then remove the /usr/bin/mv one.
- Chapter 5: Added 'make localedata/install-locales' to the Glibc installation. This installs the locale files that various applications use (most notable GDK applications) if you have an NLS capable system (which LFS is, but with missing locales it's almost useless)
- Chapter 6: Moved vim's installation before Lilo since you might want to edit Lilo's Makefile file to add compiler optimization.
- Chapter 6: Moved the installation of shadow password suit after sh-utils. Else sh-utils replaces the "su" version from shadow password with it's own version which shouldn't happen.
- Chapter 6: Changed the way we enter the chroot'ed environment. We use the "env" to create an empty environment so that environment variables from the normal Linux system won't interfere in the chroot environment. The only variable set when entering the chroot'ed environment is the HOME variable.
- Chapter 6: Because of the new way we enter chroot, the \$LFS/root/.bash\_profile file has been created that sets a few variables like TERM, CFLAGS, CXXFLAGS and whatever you deem necessary.

2.3.7 – August 3rd, 2000

- All chapters: Removed the <blockquote> SGML tags so that the contents of files isn't indented anymore. This improves the easy of copy and pasting from the book into your files without needing to manually reformat the files to get rid of the indentations.
- Chapter 4: Added var/tmp to the "chmod 1777 tmp usr/tmp" command.
- Chapter 4: Made mkdir commands less repetitive by putting the creation of the directories in \$LFS/usr and \$LFS/usr/local in a for-loop.
- Chapter 5: Moved the chmod 754 command for MAKEDEV after the sed operation.
- Chapter 5: Changed the order in which packages are installed to conform more to a alphabetically ordering.
- Chapter 5: After console-tools has been installed the /usr/share/defkeymap.kmap.gz file is created which will be used by the loadkeys script.
- Chapter 5: Removed "gcc -c watch.c" from "Installing Procps". Please let us know if this is still needed on certain hardware.
- Chapter 5: Added the /usr/bin/install symbolic link as it seems that at least one package (sysklogd) has the install location hard coded in it's Makefile file.
- Chapter 5: After gettext has been installed, we have a file /po-mode.el. This file will be moved to /usr/share/gettext where it probably belongs.
- Chapter 5: Instead of passing --with-root-prefix=/ to e2fsprogs' configure script, we now pass --with-root-prefix=
- Chapter 5: When gzip is installed and the files moved to /bin the hard link between the files is removed. So we just move gzip to /bin and create a symlink between gzip and gunzip.
- Chapter 5: In the chroot environment: changed the installation order of a few packages who's dependencies have changed over time.
- Chapter 5: inittab file has been slightly updated to better support the single user run level. When you change to run level S, s or 1 it will do it's job properly now.
- Chapter 6: Fixed typo in the rc script (! -f sysinit\_start -> ! -f \$sysinit\_start).
- Chapter 6: Changed the loadkeys command in the loadkeys script. New command is: loadkeys -d which loads the /usr/share/keymaps/defkeymap.kmap.gz file.
- Chapter 6: Changed ". /etc/init.d/functions" into "source /etc/init.d/functions".
- Chapter 6: Removed the "rm /fastboot" command from the checkfs script.

2.3.6 – July 19th, 2000

Chapter 3: Re-ordered the software download list so it once again matches the order in which packages are used (the first package listed in the list is the first package that we will be using in the book, the second listed package will be the second package used in the book, etc).

- Chapter 3: Added the file sizes of the packages you have to download.
- Chapter 3: Removed the start-stop-daemon package.
- Chapter 3: Added the findutils and glibc patches to the package list.
- Chapter 3: Added the man-pages package to the package list.
- Chapter 4: Moved the creation of the \$LFS/dev/ files to chapter 5 after we have entered the chroot environment. This is done because GID's on normal system and LFS system might differ and the MAKEDEV script depends on the GID's.
- Chapter 5: Added the installation of the man-pages package.
- Chapter 5: Added a few commonly used groups to the /etc/group file when it is created (these are the groups needed by the MAKEDEV script).
- Chapter 5: The /proc/devices file is copied to \$LFS/proc for the benefit of the MAKEDEV script. The presence of this file ensures the proper creation of the device files.
- Chapter 5: Layout changes. Every package installation has it's own page now. Also the text from appendixa for every package is included with the installation instructions so you can read what a package is about during (or after or before) the installation of it.
- Chapter 5: Removed the patches for diffutils, grep, gzip and sed that used to fix static link problems. The problems can be fixed by passing compile arguments to the C pre-processor (cpp) instead.
- Chapter 5: Added the --disable-termcap option to configure to disable termcap backward compatibility (if you want to know why termcap isn't used anymore, please read the INSTALL file that comes with the Ncurses package).
- Chapter 5: Added a few missing files from the fileutils package to the "mv" commands.
- Chapter 5: Removed the installation of the start-stop-daemon package.
- Chapter 5: Removed the -e parameters from the make command lines.
- Chapter 5: Instead of editing the procinfo, procps and psmisc Makefile files with a text editor, the sed command it used.
- Chapter 6: Added the setclock script in case your hardware clock isn't set to GMT.
- Chapter 6: Removed the use of the start-stop-daemon program and replaced them with custom functions that use programs like pidof and kill to accomplish the same tasks but with more control over what happens.
- Chapter 6: Added the loadproc and killproc functions to the /etc/init.d/functions file that take over the

functions the start–stop–daemon program used to perform.

- Chapter 6: When the checkfs script runs without errors it now prints a green OK.
- Chapter 6: When /fastboot or /forcefsck exist, they won't be deleted from within the checkfs script but from within the mountfs script as soon as the root partition has been remounted in read–write mode.
- Chapter 6 & 7: Instead of sourcing a file with ". /etc/init.d/functions", "source /etc/init.d/functions" is now used. This makes it easier to read and is clearer for persons who don't know much about scripting.
- Appendix A: removed start–stop–daemon.
- Appendix B: Removed a few unrelated items from the book and howto sections (the references to Sendmail and ISP–Hookup–HOWTO).

### 2.3.5 – June 19th, 2000

- Chapter 3: Updated LILO download location
- Chapter 3: Updated Shadow Password Suite download location
- Chapter 3: Updated the Flex download location
- Chapter 3: Updated the File download location
- Chapter 3: Added netkit–base and net–tools to the mandatory packages section
- Chapter 5: A glibc–2.1.3 patch is available if you have problems compiling glibc on a bash–2.04 machine.
- Chapter 5: Added compiler optimization
- Chapter 5: Added the creation of the root password to "Configuring essential software"
- Chapter 5: The Linux86 package has been replaced by the Bin86 package.
- Chapter 5: Included information on how to optimize compilations.
- Chapter 5: Moved installation of Groff and Man before Perl. This way Perl known how to install man pages and where to install them.
- Chapter 5: Changed GCC's local–prefix option to /usr/local instead of /usr (this was still a residue from the time where /usr/local was a symbolic link to /usr)
- Chapter 5: Fixed the commands when a patch is used and the patch filename contained the .gz suffix.
- Chapter 5: Added --disable-nls to every configure command in the "Perparing the LFS

system..." section which didn't have it yet.

- Chapter 5: Added the installation of bash-2.03 so you have a shell that can be used to compile packages that violate POSIX standards regarding valid characters in variable names
- Chapter 5: Added the installation of console-tools and console-data for people who have non-US keyboards
- Chapter 5: Moved the ed program to the /bin directory conforming the FHS standard
- Chapter 6 & 7: Implemented LSB recommended run level scheme.
- Chapter 6 & 7: Implemented "fancy bootscripts". When something fails in a bootscript it still says FAILED but the text red. When something succeeded it still will print OK but the text is green.
- Chapter 6: Added the loadkeys scripts for people with non-US keyboards
- Chapter 6: Added the /etc/sysconfig directory to "Creating directories"
- Chapter 6: Renamed the checkroot boot script into checkfs. The script also checks other file systems now.
- Chapter 6: Updated the mountfs boot script to mount all file systems that are mentioned in the /etc/fstab file and don't have the noauto option set.
- Chapter 6: After checkfs evaluated the existence of /fastboot or /forcecheck it will remove those files.
- Chapter 6 & 7: Changed the mode of the boot scripts from 755 to 754
- Chapter 7: Moved system specific information for hostname and ethernet configuration to the /etc/sysconfig/network file
- Chapter 7: Removed the default gateway command
- Chapter 7: Fixed the typo in the ethnet script (NETMAKSK -> NETMASK)
- Chapter 7: A net-tools patch is available to fix a minor bug in the package (illegal variable names that bash-2.04 will complain about)

### 2.3.4 – June 5th, 2000

- Chapter 5: Fixed the kernel header files configuration
- Chapter 5: Fixed the lilo configuration

### 2.3.3 – May 15th, 2000

-

Changed the default mount point from /mnt/xxx to /mnt/lfs (where xxx used to be the partition's designation like hda5, sda5 and others). The reason for the change is to make cross-platform instructions easier.

- Chapter 4: Changed the default modes for the \$LFS/root and \$LFS/tmp directory to respectively 0750 and 1777.
- Chapter 5: Removed the encoded password from the passwd file. Instead a file with no set password is created. The root password can be set by the user when the system is rebooted into the LFS system (after chapter 8).
- Chapter 5: Fixed the procps compile command for watch.c. It should compile properly now.
- Chapter 5: Fixed gzip patch installation (used the wrong filename in the patch command)
- Chapter 5: Changed 'entering the chroot'ed environment' to make bash a login shell.
- Chapter 5: Configuring the kernel has been moved to this chapter because it needs to be done before programs like e2fsprogs and lilo are compiled.
- Chapter 6: Fixed the rc script. It now checks to see if the previous run level starts a service before attempting to stop it in the new run level. Also, if a service is already started in the previous run level it won't attempt to start the service in the new run level again. Thanks to Jason Pearce for providing this fixed script.
- Chapter 7: Fixed the ethnet script – removed parentheses from the environment variables and removed the command to add a route. The ifconfig command used to bring the eth device up already sets this route.

### 2.3.2 – April 18th, 2000

- Chapter 4.7: Change only the owner of the \$LFS/dev/\* files
- Fixed a large amount of typo's that occurred during the transition from the LinuxDoc DTD (2.2 and lower) to the DocBook DTD (2.3.1 and higher).
- Moved chapters around quite a bit and applied a new structure in the book. Installations for Intel, Apple PowerPC and future systems will be put in their own dedicated part of the book.
- After the system is prepared to install the basic system software, we no longer reboot the system but instead we setup a chroot'ed environment. This will have the same effect without having to reboot.
- Apple PowerPC has it's own dedicated chapters now. This should increase readability a lot
- All optional chapters have been removed. LFS follows a "we provide the foundation, it's up to you to build the rest of the house" philosophy.
- Replaced the fixed packages by patch files. This way you can see what needs to be changed in a package in order to get it to compile properly.

2.3.1 – April 12th, 2000

- Chapter 4.4: Added the `$LFS/usr/info` symlink which points to `$LFS/usr/share/info`
  - Chapter 7.3.1: Added a second variation to a 'swap-line' in a `fstab` file.
  - Chapter 7.3.2: Removed `$LFS` from the commands.
  - Chapter 7.4.43: Added the `vi` symlink
  - Chapter 9.2.5: Improved `ethnet` script to include routing information
  - Chapter 10.1.2: Fixed missing subdirectory 'mqueue' in `mkdir /var/spool -> /mkdir /var/spool/mqueue`
  - Chapter 10.1.4: Updated the `sendmail` configuration file with a few necessary options
  - Chapter 10.1.7: Fixed wrong directory path `/etc/init.d/rc2.d -> /etc/rc2.d`
-

# Mailinglists and archives

The linuxfromscratch.org server is hosting the following public accessible mailinglists:

- lfs–discuss
  - lfs–config
  - lfs–apps
  - lfs–announce
  - linux
  - alfs–discuss
- 

## lfs–discuss

The lfs–discuss mailinglist discusses matters strictly related to the LFS–BOOK. If you have problems with the book, want to report a bug or two or have suggestions to improve the book, use this mailinglist.

Compilation problems, questions how to configure a piece of software and such are to be posted to the lfs–config or lfs–apps mailinglist. To find out what kind of questions go to which of the two lists you can read in the descriptions for those two lists.

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## lfs–config

The lfs–config list discusses problems with compiling, installing and configuring software that is used in the LFS–BOOK.

Problems with compiling, installing or configuring programs that didn't give problems on a non–LFS system are discussed on the lfs–apps list. If your problem doesn't fit on the lfs–config or lfs–apps mailinglist, please use the linux mailinglist.

---

## lfs–apps

The lfs–apps list discussed the compilation and configuration of software that's not used in this book. The list is mainly used when you have problems installing software on an LFS system when you don't have problems compiling it on your normal distribution. It's not that LFS is incompatible with "normal" distributions but just the fact that you might be missing support–software that programs need or need to configure a few things on

your new LFS system.

If you had problems with software on non-LFS systems as well, please use the linux mailinglist for help.

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## lfs-announce

The lfs-announce list is a moderated list. You can subscribe to it, but you can't post any messages to this list. This list is used to announce new stable releases. If you want to be informed about development releases as well then you'll have to join the lfs-discuss list. If you're already on the lfs-discuss list there's little use subscribing to this list as well because everything that is posted to the lfs-announce list will be posted to the lfs-discuss list as well.

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## linux

The linux list is a general Linux discussion list that handles everything that has got anything to do with Linux in any way, shape and form. Occasionally we discuss the price of beer as well.

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## alfs-discuss

The alfs-discuss discusses the development of ALFS which stands for Automated LinuxFromScratch. The goal of this project is to develop an installation tool that can install an LFS system automatically for you. It's main goal is to speed up compilation by taking away your need to manually enter the commands to configure, compile and install packages.

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## How to subscribe?

You can subscribe to any of the above mentioned mailinglists by sending an email to [majordomo@linuxfromscratch.org](mailto:majordomo@linuxfromscratch.org) and write *subscribe listname* in the body of the message, where listname is replaced by either lfs-discuss, lfs-config, lfs-apps, lfs-announce, linux or alfs-discuss. No subject required.

You can, if you want, subscribe to multiple lists at the same time using one email. Just repeat the subscribe command for each of the lists you want to subscribe to.

After you have sent the email, the Majordomo program will send you an email back requesting a confirmation of your subscription request. After you have sent back this confirmation email, Majordomo will send you an email again with the message that you have been subscribed to the list(s) along with an introduction message for that particular list.

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## How to unsubscribe?

To unsubscribe from a list, send an email to [majordomo@linuxfromscratch.org](mailto:majordomo@linuxfromscratch.org) and write *unsubscribe listname* in the body of the message, where listname is replaced by either lfs–discuss, lfs–config, lfs–apps, lfs–announce, linux or alfs–discuss.

You can, if you want, unsubscribe from multiple lists at the same time using one email. Just repeat the unsubscribe command for each of the lists you want to unsubscribe from.

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## Mail archives

The lfs–discuss, lfs–config, lfs–apps and linux mailing lists have an archive you can access to find information on subjects already posted to this list. You can find them at <http://www.pcrdallas.com/mail-archives>

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# Contact information

Direct all your emails to the [lfs-discuss](#) mailinglist preferably.

If you need to reach Gerard Beekmans personally, send an email to [gerard@linuxfromscratch.org](mailto:gerard@linuxfromscratch.org)

If you need to reach Michael Peters, Apple PPC maintainer of this book, personally, send an email to [mpters@mac.com](mailto:mpters@mac.com)

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# Chapter 2. Important information

# About \$LFS

Please read the following carefully: throughout this document you will frequently see the variable name \$LFS. \$LFS must at all times be replaced by the directory where the partition that contains the LFS system is mounted. How to create and where to mount the partition will be explained later on in full detail in chapter 4. In my case the LFS partition is mounted on /mnt/lfs. If I read this document myself and I see \$LFS somewhere, I will pretend that I read /mnt/lfs. If I read that I have to run this command: `cp inittab $LFS/etc` I actually will run this: `cp inittab /mnt/lfs/etc`

It's important that you do this no matter where you read it; be it in commands you enter on the prompt, or in some file you edit or create.

If you want, you can set the environment variable LFS. This way you can literally enter \$LFS instead of replacing it by something like /mnt/lfs. This is accomplished by running: `export LFS=/mnt/lfs`

If I read `cp inittab $LFS/etc`, I literally can type `cp inittab $LFS/etc` and the shell will replace this command by `cp inittab /mnt/lfs/etc` automatically.

Do not forget to set the \$LFS variable at all times. If you haven't set the variable and you use it in a command, \$LFS will be ignored and whatever is left will be executed. The command `cp inittab $LFS/etc` without the LFS variable set, will result in copying the inittab file to the /etc directory which will overwrite your system's inittab. A file like inittab isn't that big a problem as it can easily be restored, but if you would make this mistake during the installation of the C Library, you can break your system badly and might have to reinstall it if you don't know how to repair it.

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# How to download the software

Throughout this document I will assume that you have stored all the packages you have downloaded somewhere in `$LFS/usr/src`.

I use the convention of having a `$LFS/usr/src/sources` directory. Under `sources` you'll find the directory `0-9` and the directories `a` through `z`. A package as `sysvinit-2.78.tar.gz` is stored under `$LFS/usr/src/sources/s/`. A package as `bash-2.04.tar.gz` is stored under `$LFS/usr/src/sources/b/` and so forth. You don't have to follow this convention of course, I was just giving an example. It's better to keep the packages out of `$LFS/usr/src` and move them to a subdirectory, so we'll have a clean `$LFS/usr/src` directory in which we will unpack the packages and work with them.

The next chapter contains the list of all the packages you need to download, but the partition that is going to contain our LFS system isn't created yet. Therefore store the files temporarily somewhere where you want and remember to copy them to `$LFS/usr/src/` when you have finished the chapter in which you prepare a new partition (which chapter exactly depends on your architecture).

---

# How to install the software

Before you can actually start doing something with a package, you need to unpack it first. Often you will find the package files being tar'ed and gzip'ed (you can see this from a .tar.gz or .tgz extension). I'm not going to write down every time how to ungzipped and how to untar an archive. I will tell you how to do that once, in this paragraph. There is also the possibility that you have the ability of downloading a .tar.bz2 file. Such a file is tar'ed and compressed with the bzip2 program. Bzip2 achieves a better compression than the commonly used gzip does. In order to use bz2 archives you need to have the bzip2 program installed. Most if not every distribution comes with this program so chances are high it is already installed on your system. If not, install it using your distribution's installation tool.

To start with, change to the \$LFS/usr/src directory by running:

```
root:~# cd $LFS/usr/src
```

When you have a file that is tar'ed and gzip'ed, you unpack it by running either one of the following two commands, depending on the filename format:

```
root:/usr/src# tar xvfz filename.tar.gz
root:/usr/src# tar xvfz filename.tgz
```

When you have a file that is tar'ed and bzip'ed, you unpack it by running:

```
root:/usr/src# bzipcat filename.tar.bz2 | tar xv
```

Some tar programs (most of them nowadays but not all of them) are slightly modified to be able to use bzip2 files directly using either the I or the y tar parameter which works the same as the z tar parameter to handle gzip archives.

When you have a file that is tar'ed, you unpack it by running:

```
root:/usr/src# tar xvf filename.tar
```

When the archive is unpacked a new directory will be created under the current directory (and this document assumes that you unpack the archives under the \$LFS/usr/src directory). You have to enter that new directory before you continue with the installation instructions. So everytime the book is going to install a program, it's up to you to unpack the source archive.

After you have installed a package you can do two things with it. You can either delete the directory that contains the sources or you can keep it. If you decide to keep it, that's fine by me. But if you need the same package again in a later chapter you need to delete the directory first before using it again. If you don't do this, you might end up in trouble because old settings will be used (settings that apply to your normal Linux system but which don't always apply to your LFS system). Doing a simple make clean does not always guarantee a totally clean source tree. The configure script can also have files lying around in various subdirectories which aren't always removed by a make clean process.

## II. Part II – Installing the LFS system

### *Table of Contents*

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  4. [Preparing a new partition](#)
  5. [Preparing the LFS system](#)
  6. [Installing basic system software](#)
  7. [Creating system boot scripts](#)
  8. [Setting up basic networking](#)
  9. [Making the LFS system bootable](#)
-

## Chapter 3. Packages you need to download

Below is a list of all the packages you need to download for building the basic system. The version numbers printed correspond to versions of the software that is known to work and which this book is based on. If you experience problems which you can't solve yourself, download the version that is assumed in this book (in case you download a newer version).

The listed file sizes refer to the sizes of the .tar.gz archives. Sometimes you can find .tar.bz2 archives, but as .tar.gz is still the most widely used format, that size is listed.

- Bash (2.04) – 1,668 KB: <ftp://ftp.gnu.org/gnu/bash/>
- Binutils (2.10) 7,041 KB: <ftp://ftp.gnu.org/gnu/binutils/>
- Bzip2 (1.0.1) 460 KB: <http://sourceware.cygnum.com/bzip2/>
- Diff Utils (2.7) 304 KB: <ftp://ftp.gnu.org/gnu/diffutils/>
- File Utils (4.0) 1,143 KB: <ftp://ftp.gnu.org/gnu/fileutils/>
- GCC (2.95.2) 12,583 KB: <ftp://ftp.gnu.org/gnu/gcc/>
- Linux Kernel (2.2.16) 16,705 KB: <ftp://ftp.kernel.org/pub/linux/kernel/>
- Glibc (2.1.3) 8,802 KB: <ftp://ftp.gnu.org/gnu/glibc/>
- Glibc-crypt (2.1.3) 39 KB: <ftp://ftp.gwdg.de/pub/linux/glibc/>
- Glibc-linuxthreads (2.1.3) 149 KB: <ftp://ftp.gnu.org/gnu/glibc/>
- Glibc Patch (2.1.3) – 1 KB: <http://www.linuxfromscratch.org/download/glibc-2.1.3.patch.gz>
- Grep (2.4.2) 449 KB: <ftp://ftp.gnu.org/gnu/grep/>
- Gzip (1.2.4a) 215 KB: <ftp://ftp.gnu.org/gnu/gzip/>
- Make (3.79.1) 1,006 KB: <ftp://ftp.gnu.org/gnu/make/>
- Sed (3.02) 258 KB: <ftp://ftp.gnu.org/gnu/sed/>
- Shell Utils (2.0) 1,214 KB: <ftp://ftp.gnu.org/gnu/sh-utils/>
- Tar (1.13) 1,027 KB: <ftp://ftp.gnu.org/gnu/tar/>
- Text Utils (2.0) 1,496 KB: <ftp://ftp.gnu.org/gnu/textutils/>
- MAKEDEV (2.5) – 11 KB: <ftp://ftp.ihg.uni-duisburg.de/Linux/system>
-

- Bison (1.28) 410 KB: <ftp://ftp.gnu.org/gnu/bison/>
- Mawk (1.3.3) 205 KB: <ftp://ftp.whidbey.net/pub/brennan/>
- Patch (2.5.4) 182 KB: <ftp://ftp.gnu.org/gnu/patch/>
- Find Utils (4.1) 287 KB: <ftp://ftp.gnu.org/gnu/findutils/>
- Find Utils Patch (4.1) 1 KB: <http://www.linuxfromscratch.org/download/findutils-4.1.patch.gz>
- Ncurses (5.1) 1,671 KB: <ftp://ftp.gnu.org/gnu/ncurses/>
- Less (358) 225 KB: <ftp://ftp.gnu.org/gnu/less/>
- Groff (1.16) 1,393 KB: <ftp://ftp.gnu.org/gnu/groff/>
- Man (1.5h1) 174 KB: <ftp://ftp.win.tue.nl/pub/linux-local/utils/man/>
- Perl (5.6.0) 5,316 KB: <http://www.perl.com>
- M4 (1.4) 310 KB: <ftp://ftp.gnu.org/gnu/m4/>
- Texinfo (4.0) 1,106 kB <ftp://ftp.gnu.org/gnu/texinfo/>
- Autoconf (2.13) 433 KB: <ftp://ftp.gnu.org/gnu/autoconf/>
- Automake (1.4) 344 KB: <ftp://ftp.gnu.org/gnu/automake/>
- Flex (2.5.4a) 372 KB: <ftp://ftp.gnu.org/non-gnu/flex/>
- File (3.31) 135 KB: <ftp://ftp.gw.com/mirrors/pub/unix/file/>
- Libtool (1.3.5) 526 KB: <ftp://ftp.gnu.org/gnu/libtool/>
- Bin86 (0.15.1) 138 KB: <http://www.cix.co.uk/~mayday/>
- Gettext (0.10.35) 696 KB: <ftp://ftp.gnu.org/gnu/gettext/>
- Console-tools (0.2.3) 652 KB: <ftp://metalab.unc.edu/pub/Linux/system/keyboards/>
- Console-tools (0.2.3) Patch: 4 KB:  
<http://www.linuxfromscratch.org/download/console-tools-0.2.3.patch.gz>
- Console-data (1999.08.29) 534 KB: <ftp://metalab.unc.edu/pub/Linux/system/keyboards/>
- E2fsprogs (1.19) 935 KB: <http://e2fsprogs.sourceforge.net>
- Ed (0.2) 181 KB: <ftp://ftp.gnu.org/gnu/ed/>
- Ld.so (1.9.9) 346 KB: <http://www.linuxfromscratch.org/download/ld.so-1.9.9.tar.gz>
-

- Lilo (21.5) 209 KB: <ftp://brun.dyndns.org/pub/linux/lilo/>
  - 
  - Modutils (2.3.13) 197 KB: <ftp://ftp.ocs.com.au/pub/modutils/>
  - 
  - Vim-rt (5.7) 1,073 KB: <ftp://ftp.vim.org/pub/editors/vim/unix/>
  - 
  - Vim-src (5.7) 1,202 KB: <ftp://ftp.vim.org/pub/editors/vim/unix/>
  - 
  - Procinfo (17) 22 KB: <ftp://ftp.cistron.nl/pub/people/svm/>
  - 
  - Procps (2.0.7) 191 KB: <ftp://people.redhat.com/johnsonm/procps/>
  - 
  - Psmisc (19) 21 KB: <ftp://lrcftp.epfl.ch/pub/linux/local/psmisc/>
  - 
  - Shadow Password Suite (19990827) 706 KB: <ftp://ftp.ists.pwr.wroc.pl/pub/linux/shadow/>
  - 
  - Sysklogd (1.3.31) 93 KB: <ftp://sunsite.unc.edu/pub/Linux/system/daemons/>
  - 
  - Sysvinit (2.78) 106 KB: <ftp://ftp.cistron.nl/pub/people/miquels/sysvinit/>
  - 
  - Util Linux (2.10m) 1,178 KB: <ftp://ftp.win.tue.nl/pub/linux/utils/util-linux/>
  - 
  - Man-pages (1.30) 651 KB: <ftp://ftp.win.tue.nl/pub/linux/docs/manpages/>
  - 
  - Netkit-base (0.17) 55 KB: <ftp://ftp.uk.linux.org/pub/linux/Networking/netkit/>
  - 
  - Net-tools (1.57) 254 KB: <http://www.tazenda.demon.co.uk/phil/net-tools/>
  - 
  - Total size of all packages: 77,105 KB (75.30 MB)
-

# Chapter 4. Preparing a new partition

# Introduction

In this chapter the partition that is going to host the LFS system is going to be prepared. A new partition will be created, an ext2 file system will be created on it and the directory structure will be created. When this is done, we can move on to the next chapter and start building a new Linux system from scratch.

---

## Creating a new partition

Before we can build our new Linux system, we need to have an empty Linux partition on which we can build our new system. I recommend a partition size of around 750 MB. This gives you enough space to store all the tarballs and to compile all packages without worrying running out of the necessary temporary disk space. If you already have a Linux Native partition available, you can skip this subsection.

Start the fdisk program (or some other fdisk program you prefer) with the appropriate hard disk as the option (like /dev/hda if you want to create a new partition on the primary master IDE disk). Create a Linux Native partition, write the partition table and exit the fdisk program. If you get the message that you need to reboot your system to ensure that that partition table is updated, then please reboot your system now before continuing. Remember what your new partition's designation is. It could be something like hda11 (as it is in my case). This newly created partition will be referred to as the LFS partition in this book.

---

# Creating a ext2 file system on the new partition

Once the partition is created, we have to create a new ext2 file system on that partition. To create a new ext2 file system we use the `mke2fs` command. Enter the new partition as the only option and the file system will be created. If your partition is `hda11`, you would run:

```
root:~# mke2fs /dev/hda11
```

---

# Mounting the new partition

Now that we have created the ext2 file system, it is ready for use. All we have to do to be able to access it (as in reading from and writing data to it) is mounting it. If you mount it under /mnt/lfs, you can access this partition by going to the /mnt/lfs directory and then do whatever you need to do. This document will assume that you have mounted the partition on a subdirectory under /mnt. It doesn't matter which directory you choose (or you can use just the /mnt directory as the mount point) but this book will assume /mnt/lfs in the commands it tells you to execute.

Create the /mnt/lfs directory by running:

```
root:~# mkdir -p /mnt/lfs
```

Now mount the LFS partition by running:

```
root:~# mount /dev/xxx /mnt/lfs
```

Replace "xxx" by your partition's designation.

This directory (/mnt/lfs) is the \$LFS variable you have read about earlier. So if you read somewhere to "cp inittab \$LFS/etc" you actually will type "cp inittab /mnt/lfs/etc". Or if you want to use the \$LFS environment variable, execute **export LFS=/mnt/lfs** now.

---

# Creating directories

Let's create the directory tree on the LFS partition according to the FHS standard which can be found at <http://www.pathname.com/fhs/>. Issuing the following commands will create the necessary directories:

```
root:~# cd $LFS
root:~# mkdir bin boot dev dev/pts etc home lib mnt proc root
sbin tmp var
root:~# for dirname in $LFS/usr $LFS/usr/local
> do
> mkdir $dirname
> cd $dirname
> mkdir bin etc include lib sbin share src tmp var
> ln -s share/man man
> ln -s share/doc doc
> ln -s share/info info
> cd $dirname/share
> mkdir dict doc info locale man nls misc terminfo zoneinfo
> cd $dirname/share/man
> mkdir man1 man2 man3 man4 man5 man6 man7 man8
> done
root:~# cd $LFS/var
root:var# mkdir lock log mail run spool tmp
```

Normally directories are created with permission mode 755, which isn't desired for all directories. I haven't checked the FHS if they suggest default modes for certain directories, so I'll just change the modes for two directories. The first change is a mode 0750 for the \$LFS/root directory. This is to make sure that not just everybody can enter the /root directory (the same you would do with /home/username directories). The second change is a mode 1777 for the \$LFS/tmp directory. This way every user can write stuff to the /tmp directory if they need to. The sticky (1) bit makes sure users can't delete other user's file which they normally can do because the directory is set in such a way that every body (owner, group, world) can write to that directory.

```
root:~# cd $LFS
root:lfs# chmod 0750 root
root:lfs# chmod 1777 tmp usr/tmp var/tmp
```

Now that the directories are created, copy the source files you have downloaded in chapter 3 to some subdirectory under \$LFS/usr/src (you will need to create this subdirectory yourself).

---

# Chapter 5. Preparing the LFS system

# How and why things are done

In this chapter we will install all the software that belongs to a basic Linux system. After you're done with this chapter you have a fully working Linux system. The remaining chapters deal with setting up networking, creating the boot scripts and adding an entry to `lilo.conf` so that you can boot your LFS system.

The software in this chapter will be linked statically. These programs will be re-installed in the next chapter and linked dynamically. The reason for the static version first is that there is a chance that our normal Linux system and your LFS system aren't using the same C Library versions. If the programs in the first part are linked against an older C library version, those programs might not work well on the LFS system.

The key to learn what makes Linux tick is to know exactly what packages are used for and why you or the system needs them. In depth descriptions of the package are provided after the Installation subsection of each package and in Appendix A as well.

We're about to start with installing the first set of packages. These packages will be, as previously explained, linked statically.

Before we start, make sure you have the LFS environment variable setup if you plan on using it, by running the following command:

```
root:~# echo $LFS
```

---

# Installing Bash

## Installation of Bash

Install Bash by running the following commands:

```
root:~# ./configure --enable-static-link \  
> --prefix=/usr --disable-nls  
root:~# make  
root:~# make prefix=$LFS/usr install  
root:~# mv $LFS/usr/bin/bash \  
> $LFS/usr/bin/bashbug $LFS/bin  
root:~# cd $LFS/bin  
root:bin# ln -s bash sh
```

---

## Contents

The Bash package contains the bash program

---

## Description

Bash is the Bourne–Again SHell, which is a widely used command interpreter on Unix systems. Bash is a program that reads from standard input, the keyboard. You type something and the program will evaluate what you have typed and do something with it, like running a program.

---

# Installing Binutils

## Installation of Binutils

Install Binutils by running the following commands:

```
root:binutils-2.10# ./configure --prefix=/usr --disable-nls
root:binutils-2.10# make -e LDFLAGS=-all-static tooldir=/usr
root:binutils-2.10# make -e prefix=$LFS/usr \
> tooldir=$LFS/usr install
```

---

## Description

The Binutils package contains the ld, as, ar, nm, objcopy, objdump, ranlib, size, strings, strip, c++filt, addr2line and nlmconv programs

---

## Description

### ld

ld combines a number of object and archive files, relocates their data and ties up symbol references. Often the last step in building a new compiled program to run is a call to ld.

---

### as

as is primarily intended to assemble the output of the GNU C compiler gcc for use by the linker ld.

---

### ar

The ar program creates, modifies, and extracts from archives. An archive is a single file holding a collection of other files in a structure that makes it possible to retrieve the original individual files (called members of the archive).

---

### nm

nm lists the symbols from object files.

---

## **objcopy**

objcopy utility copies the contents of an object file to another. objcopy uses the GNU BFD Library to read and write the object files. It can write the destination object file in a format different from that of the source object file.

---

## **objdump**

objdump displays information about one or more object files. The options control what particular information to display. This information is mostly useful to programmers who are working on the compilation tools, as opposed to programmers who just want their program to compile and work.

---

## **ranlib**

ranlib generates an index to the contents of an archive, and stores it in the archive. The index lists each symbol defined by a member of an archive that is a relocatable object file.

---

## **size**

size lists the section sizes —and the total size— for each of the object files objfile in its argument list. By default, one line of output is generated for each object file or each module in an archive.

---

## **strings**

For each file given, strings prints the printable character sequences that are at least 4 characters long (or the number specified with an option to the program) and are followed by an unprintable character. By default, it only prints the strings from the initialized and loaded sections of object files; for other types of files, it prints the strings from the whole file.

strings is mainly useful for determining the contents of non-text files.

---

## **strip**

strip discards all or specific symbols from object files. The list of object files may include archives. At least one object file must be given. strip modifies the files named in its argument, rather than writing modified copies under different names.

---

## **c++filt**

The C++ language provides function overloading, which means that you can write many functions with the same name (providing each takes parameters of different types). All C++ function names are encoded into a low-level assembly label (this process is known as mangling). The `c++filt` program does the inverse mapping: it decodes (demangles) low-level names into user-level names so that the linker can keep these overloaded functions from clashing.

---

## **addr2line**

`addr2line` translates program addresses into file names and line numbers. Given an address and an executable, it uses the debugging information in the executable to figure out which file name and line number are associated with a given address.

---

## **nlmconv**

`nlmconv` converts relocatable object files into the NetWare Loadable Module files, optionally reading header files for NLM header information.

---

# Installing Bzip2

## Installation of Bzip2

Install Bzip2 by running the following commands:

```
root:bzip2-1.0.1# sed \
> s/"\$(CC) \$(CFLAGS) -o"/"\$(CC) \$(CFLAGS) \$(LDFLAGS)
-o"/ \
> Makefile | make -f /dev/stdin LDFLAGS=-static
root:bzip2-1.0.1# make PREFIX=$LFS/usr install
root:bzip2-1.0.1# cd $LFS/usr/bin
root:bin# mv bzip2 bzip2recover $LFS/bin
```

---

## Contents

The Bzip2 packages contains the bzip2, bunzip2, bzip2recover programs.

---

## Description

### Bzip2

bzip2 compresses files using the Burrows–Wheeler block sorting text compression algorithm, and Huffman coding. Compression is generally considerably better than that achieved by more conventional LZ77/LZ78-based compressors, and approaches the performance of the PPM family of statistical compressors.

---

### Bunzip2

Bunzip2 decompresses files that are compressed with bzip2.

---

### bzcat

bzcat (or bzip2 -dc) decompresses all specified files to the standard output.

---

## **bzip2recover**

bzip2recover recovers data from damaged bzip2 files.

---

# Installing Diffutils

## Installation of Diffutils

Install Diffutils by running the following commands:

```
root:diffutils-2.7#  
CPPFLAGS=-Dre_max_failures=re_max_failures2 \  
> ./configure --prefix=/usr --disable-nls  
root:diffutils-2.7# make LDFLAGS=-static  
root:diffutils-2.7# make prefix=$LFS/usr install
```

---

## Contents

The Diffutils package contains the cmp, diff, diff3 and sdiff programs.

---

## Description

### cmp and diff

cmp and diff both compare two files and report their differences. Both programs have extra options which compare files in different situations.

---

### diff3

The difference between diff and diff3 is that diff compares 2 files, diff3 compares 3 files.

---

### sdiff

sdiff merges two two files and interactively outputs the results.

---

# Installing Fileutils

## Installation of Fileutils

Install Fileutils by running the following commands:

```
root:fileutils-4.0# ./configure --disable-nls --prefix=/usr
root:fileutils-4.0# make LDFLAGS=-static
root:fileutils-4.0# make prefix=$LFS/usr install
root:fileutils-4.0# cd $LFS/usr/bin
root:bin# mv chgrp chmod chown cp dd df dir $LFS/bin
root:bin# mv dircolors du install ln ls mkdir mkfifo $LFS/bin
root:bin# mv mknod mv rm rmdir sync touch vdir $LFS/bin
root:bin# ln -s ../../bin/install install
```

---

## Contents

The Fileutils package contains the chgrp, chmod, chown, cp, dd, df, dir, dircolors, du, install, ln, ls, mkdir, mkfifo, mknod, mv, rm, rmdir, sync, touch and vdir programs.

---

## Description

### chgrp

chgrp changes the group ownership of each given file to the named group, which can be either a group name or a numeric group ID.

---

### chmod

chmod changes the permissions of each given file according to mode, which can be either a symbolic representation of changes to make, or an octal number representing the bit pattern for the new permissions.

---

### chown

chown changes the user and/or group ownership of each given file.

---

## **cp**

cp copies files from one place to another.

---

## **dd**

dd copies a file (from the standard input to the standard output, by default) with a user-selectable blocksize, while optionally performing conversions on it.

---

## **df**

df displays the amount of disk space available on the filesystem containing each file name argument. If no file name is given, the space available on all currently mounted filesystems is shown.

---

## **ls, dir and vdir**

dir and vdir are versions of ls with different default output formats. These programs list each given file or directory name. Directory contents are sorted alphabetically. For ls, files are by default listed in columns, sorted vertically, if the standard output is a terminal; otherwise they are listed one per line. For dir, files are by default listed in columns, sorted vertically. For vdir, files are by default listed in long format.

---

## **dircolors**

dircolors outputs commands to set the LS\_COLOR environment variable. The LS\_COLOR variable is used to change the default color scheme used by ls and related utilities.

---

## **du**

du displays the amount of disk space used by each argument and for each subdirectory of directory arguments.

---

## **install**

install copies files and sets their permission modes and, if possible, their owner and group.

---

## **ln**

ln makes hard or soft (symbolic) links between files.

---

## **mkdir**

mkdir creates directories with a given name.

---

## **mkfifo**

mkfifo creates a FIFO with each given name.

---

## **mknod**

mknod creates a FIFO, character special file, or block special file with the given file name.

---

## **mv**

mv moves files from one directory to another or renames files, depending on the arguments given to mv.

---

## **rm**

rm removes files or directories.

---

## **rmdir**

rmdir removes directories, if they are empty.

---

## **sync**

sync forces changed blocks to disk and updates the super block.

---

## **touch**

touch changes the access and modification times of each given file to the current time. Files that do not exist are created empty.

---

# Installing GCC on the normal system if necessary

## Installation of GCC on the normal system if necessary

In order to compile Glibc-2.1.3 later on you need to have gcc-2.95.2 installed. Although any GCC version above 2.8 would do, 2.95.2 is the highly recommended version to use. egcs-2.91.x is also known to work. If you don't have gcc-2.95.x or egcs-2.91.x you need to install gcc-2.95.2 on your normal system before you can compile Glibc later in this chapter.

To find out which compiler version your systems has, run the following command:

```
root:~# gcc --version
```

If your normal Linux system does not have gcc-2.95.x or egcs-2.91.x installed you need to install it now. We won't replace the current compiler on your system, but instead we will install gcc in a separate directory (/usr/local/gcc2952). This way no binaries or header files will be replaced.

After you unpacked the gcc-2.95.2 archive don't enter the newly created gcc-2.95.2 directory but stay in the \$LFS/usr/src directory. Install GCC by running the following commands:

```
root:src# mkdir $LFS/usr/src/gcc-build
root:src# cd $LFS/usr/src/gcc-build
root:gcc-build# ../gcc-2.95.2/configure \
> --prefix=/usr/local/gcc2952 \
> --with-local-prefix=/usr/local/gcc2952 \
> --with-gxx-include-dir=/usr/local/gcc2952/include/g++ \
> --enable-shared --enable-languages=c,c++
root:gcc-build# make bootstrap
root:gcc-build# make install
```

---

## Contents

The GCC package contains compilers, preprocessors and the GNU C++ Library.

---

## Description

## Compiler

A compiler translates source code in text format to a format that a computer understands. After a source code file is compiled into an object file, a linker will create an executable file from one or more of these compiler generated object files.

---

## Pre-processor

A pre-processor pre-processes a source file, such as including the contents of header files into the source file. You generally don't do this yourself to save yourself a lot of time. You just insert a line like `#include <filename>`. The pre-processor file insert the contents of that file into the source file. That's one of the things a pre-processor does.

---

## C++ Library

The C++ library is used by C++ programs. The C++ library contains functions that are frequently used in C++ programs. This way the programmer doesn't have to write certain functions (such as writing a string of text to the screen) from scratch every time he creates a program.

---

# Installing GCC on the LFS system

## Installation of GCC on the LFS system

After you unpacked the gcc-2.95.2 archive don't enter the newly created gcc-2.95.2 directory but stay in the \$LFS/usr/src directory. Install GCC by running the following commands:

```
root:src# mkdir $LFS/usr/src/gcc-build
root:src# cd $LFS/usr/src/gcc-build
root:gcc-build# ../gcc-2.95.2/configure --prefix=/usr \
> --with-gxx-include-dir=/usr/include/g++ \
> --enable-languages=c,c++ --disable-nls
root:gcc-build# make -e LDFLAGS=-static bootstrap
root:gcc-build# make prefix=$LFS/usr
local_prefix=$LFS/usr/local \
> gxx_include_dir=$LFS/usr/include/g++ install
```

---

## Creating necessary symlinks

The system needs a few symlinks to ensure every program is able to find the compiler and the pre-processor. Some programs run the cc program, others run the gcc program. Some programs expect the cpp program in /lib and others expect to find it in /usr/bin. Create those symlinks by running:

Replace <host> with the directory where the gcc-2.95.2 files are installed (which is i686-unknown-linux in my case). Create the symlinks by running:

```
root:~# cd $LFS/lib
root:lib# ln -s ../usr/lib/gcc-lib/<host>/2.95.2/cpp cpp
root:lib# cd $LFS/usr/lib
root:lib# ln -s gcc-lib/<host>/2.95.2/cpp cpp
root:lib# cd $LFS/usr/bin
root:bin# ln -s gcc cc
```

---

## Contents

The GCC package contains compilers, preprocessors and the GNU C++ Library.

---

## Description Compiler

A compiler translates source code in text format to a format that a computer understands. After a source code file is compiled into an object file, a linker will create an executable file from one or more of these compiler generated object files.

---

## Pre-processor

A pre-processor pre-processes a source file, such as including the contents of header files into the source file. You generally don't do this yourself to save yourself a lot of time. You just insert a line like `#include <filename>`. The pre-processor file insert the contents of that file into the source file. That's one of the things a pre-processor does.

---

## C++ Library

The C++ library is used by C++ programs. The C++ library contains functions that are frequently used in C++ programs. This way the programmer doesn't have to write certain functions (such as writing a string of text to the screen) from scratch every time he creates a program.

---

# Installing Linux Kernel

## Installation of Linux Kernel

We won't be compiling a new kernel image yet. We'll do that after we have finished the installation of the basic system software in this chapter. But because certain software need the kernel header files, we're going to unpack the kernel archive now and set it up so that we can compile package that need the kernel.

Create the kernel configuration file by running the following command:

```
root:linux# yes "" | make config
```

Ignore the warning *Broken pipe* you might see at the end. Now run the following commands to set up all the dependencies correctly:

```
root:linux# make dep
```

Now that that's done, we need to create the `$LFS/usr/include/linux` and the `$LFS/usr/include/asm` symlinks. Create them by running the following commands:

```
root:~# cd $LFS/usr/include
root:include# ln -s ../src/linux/include/linux linux
root:include# ln -s ../src/linux/include/asm asm
```

---

## Contents

The Linux kernel package contains the Linux kernel.

---

## Description

The Linux kernel is at the core of every Linux system. It's what makes Linux tick. When you turn on your computer and boot a Linux system, the very first piece of Linux software that gets loaded is the kernel. The kernel initializes the system's hardware components such as serial ports, parallel ports, sound cards, network cards, IDE controllers, SCSI controllers and a lot more. In a nutshell the kernel makes the hardware available so that the software can run.

---

# Installing Glibc

## A note on the glibc-crypt package

An excerpt from the README file that is distributed with the glibc-crypt package:

The add-on is not included in the main distribution of the GNU C library because some governments, most notably those of France, Russia, and the US, have very restrictive rules governing the distribution and use of encryption software. Please read the node "Legal Problems" in the manual for more details.

In particular, the US does not allow export of this software without a licence, including via the Internet. So please do not download it from the main FSF FTP site at ftp.gnu.org if you are outside the US. This software was completely developed outside the US.

"This software" refers to the glibc-crypt package at ftp://ftp.gwdg.de/pub/linux/glibc/. This law only affects people who don't live in the US. It's not prohibited to import DES software, so if you live in the US you can import the file safely from Germany without breaking cryptographic laws. This law is changing lately and I don't know what the status of it is at the moment. Better be safe than sorry.

---

## Installation of Glibc

Unpack the glibc-crypt and glibc-linuxthreads in the glibc-2.1.3 directory, not in /usr/src. Don't enter the created directories. Just unpack them and leave it with that.

A few default parameters of Glibc need to be changed, such as the directory where the shared libraries are supposed to be installed in and the directory that contains the system configuration files. For this purpose you need to create the `$LFS/usr/src/glibc-build` directory and `cd` into that directory with:

```
root:src# mkdir $LFS/usr/src/glibc-build
root:src# cd $LFS/usr/src/glibc-build
```

In that directory you create a new file `configparms` containing the following:

```
# Begin configparms
slibdir=/lib
sysconfdir=/etc
# End configparms
```

If you're getting errors related to illegal character 45 in some variable name during the compilation, apply the Glibc patch to the glibc-2.1.3 directory by running the following command:

```
root:glibc-2.1.3# patch -Np1 -i ../glibc-2.1.3.patch
```

Please note that the configure script of Glibc can complain about certain files in the `/usr/include` directory being too old and will be replaced, or that some symlink is not supposed to be there anymore (like the `/usr/include/scsi` symlink that's present on older Linux systems). If it asks you to move a symlink like `scsi` out of the way, please do so. If it says it will replace old files by the newer Glibc files you can ignore that. Glibc does not know that it will end up on `$LFS` when the configure script is run.

If your system had already a suitable GCC version installed, change to the `$LFS/usr/src/glibc-build` directory and install Glibc by running the following commands:

```
root:glibc-build# ./glibc-2.1.3/configure \
> --prefix=/usr --enable-add-ons \
> --with-headers=$LFS/usr/include
root:glibc-build# make
root:glibc-build# make install_root=$LFS install
root:glibc-build# make install_root=$LFS
localedata/install-locales
root:glibc-build# localedef -i en_US -f ISO-8859-1 en_US
```

In the above `localedef` command you will have to replace "en\_US" and "ISO-8859-1" with the proper values for your localization needs. You can find out what's available by looking in the `/usr/share/locale` directory.

If your system didn't have a suitable GCC version installed, change to the `$LFS/usr/src/glibc-build` directory and install Glibc using the `gcc-2.95.2` you just installed by running the following commands:

```
root:glibc-build# CC=/usr/local/gcc2952/bin/gcc \
> ./glibc-2.1.3/configure --prefix=/usr --enable-add-ons \
> --with-headers=$LFS/usr/include
root:glibc-build# make
root:glibc-build# make install_root=$LFS install
root:glibc-build# make install_root=$LFS
localedata/install-locales
```

---

## Copying old NSS library files

If your normal Linux system runs `glibc-2.0`, you need to copy the NSS library files to the `LFS` partition. Certain statically linked programs still depend on the NSS library, especially programs that need to lookup usernames, userids and groupids. You can check which C library version your normal Linux system uses by running:

```
root:~# ls /lib/libc*
```

Your system uses glibc-2.0 if there is a file that looks like *libc-2.0.7.so*

Your system uses glibc-2.1 if there is a file that looks like *libc-2.1.3.so*

Of course, the micro version number can be different (you could have libc-2.1.2 or libc-2.1.1 for example).

If you have a libc-2.0.x file copy the NSS library files by running:

```
root:~# cp -av /lib/libnss* $LFS/lib
```

There are a few distributions that don't have files from which you can see which version of the C Library it is. If that's the case, it will be hard to determine which C library version you exactly have. Try to obtain this information using your distribution's installation tool. It often says which version it has available. If you can't figure out at all which C Library version is used, then copy the NSS files anyway and hope for the best. That's the best advise I can give I'm afraid.

---

## Contents

The Glibc package contains the GNU C Library.

---

## Description

The C Library is a collection of commonly used functions in programs. This way a programmer doesn't need to create his own functions for every single task. The most common things like writing a string to your screen are already present and at the disposal of the programmer.

The C library (actually almost every library) come in two flavours: dynamic ones and static ones. In short when a program uses a static C library, the code from the C library will be copied into the executable file. When a program uses a dynamic library, that executable will not contain the code from the C library, but instead a routine that loads the functions from the library at the time the program is run. This means a significant decrease in the file size of a program. If you don't understand this concept, you better read the documentation that comes with the C Library as it is too complicated to explain here in one or two lines.

---

# Installing Grep

## Installation of Grep

Install Grep by running the following commands:

```
root@grep-2.4.2# CPPFLAGS=-Dre_max_failures=re_max_failures2 \  
> ./configure --prefix=/usr --disable-nls  
root@grep-2.4.2# make LDFLAGS=-static  
root@grep-2.4.2# make prefix=$LFS/usr install
```

---

## Contents

The grep package contains the egrep, fgrep and grep programs.

---

## Description

### egrep

egrep prints lines from files matching an extended regular expression pattern.

---

### fgrep

fgrep prints lines from files matching a list of fixed strings, separated by newlines, any of which is to be matched.

---

### grep

grep prints lines from files matching a basic regular expression pattern.

---

# Installing Gzip

## Installation of Gzip

This package is known to cause compilation problems on certain platforms. If you're having trouble compiling this package as well, you can download a patch from

<http://www.linuxfromscratch.org/download/gzip-1.2.4a.patch.gz>

Install this patch by running the following command:

```
root@gzip-1.2.4a# patch -Np1 -i ../gzip-1.2.4a.patch
```

Install Gzip by running the following commands:

```
root@gzip-1.2.4a# ./configure --prefix=/usr --disable-nls
root@gzip-1.2.4a# make LDFLAGS=-static
root@gzip-1.2.4a# make prefix=$LFS/usr install
root@gzip-1.2.4a# cp $LFS/usr/bin/gunzip $LFS/usr/bin/gzip
$LFS/bin
root@gzip-1.2.4a# rm $LFS/usr/bin/gunzip $LFS/usr/bin/gzip
```

---

## Contents

The Gzip package contains the gunzip, gzexe, gzip, zcat, zcmp, zdiff, zforce, zgrep, zmore and znew programs.

---

## Description

### gunzip

gunzip decompresses files that are compressed with gzip.

---

### gzexe

gzexe allows you to compress executables in place and have them automatically uncompress and execute when you run them (at a penalty in performance).

---

## **gzip**

gzip reduces the size of the named files using Lempel–Ziv coding (LZ77).

---

## **zcat**

zcat uncompresses either a list of files on the command line or its standard input and writes the uncompressed data on standard output

---

## **zcmp**

zcmp invokes the cmp program on compressed files.

---

## **zdiff**

zdiff invokes the diff program on compressed files.

---

## **zforce**

zforce forces a .gz extension on all gzip files so that gzip will not compress them twice. This can be useful for files with names truncated after a file transfer.

---

## **zgrep**

zgrep invokes the grep program on compressed files.

---

## **zmore**

Zmore is a filter which allows examination of compressed or plain text files one screenful at a time on a soft-copy terminal (similar to the more program).

---

## **znew**

Znew recompresses files from .Z (compress) format to .gz (gzip) format.

---

# Installing Make

## Installation of Make

Install Make by running the following commands:

```
root:make-3.79.1# ./configure --prefix=/usr --disable-nls
root:make-3.79.1# make LDFLAGS=-static
root:make-3.79.1# make prefix=$LFS/usr install
```

---

## Contents

The Make package contains the make program.

---

## Description

make determine automatically which pieces of a large program need to be recompiled, and issue the commands to recompile them.

---

# Installing Sed

## Installation of Sed

Install Sed by running the following commands:

```
root:sed-3.02# CPPFLAGS=-Dre_max_failures=re_max_failures2 \  
> ./configure --prefix=/usr --disable-nls  
root:sed-3.02# make LDFLAGS=-static  
root:sed-3.02# make prefix=$LFS/usr install  
root:sed-3.02# mv $LFS/usr/bin/sed $LFS/bin
```

---

## Contents

The Sed package contains the sed program.

---

## Description

sed is a stream editor. A stream editor is used to perform basic text transformations on an input stream (a file or input from a pipeline).

---

# Installing Shellutils

## Installation of Shellutils

Install Shellutils by running the following commands:

```
root:sh-utils-2.0# ./configure --prefix=/usr --disable-nls
root:sh-utils-2.0# make LDFLAGS=-static
root:sh-utils-2.0# make prefix=$LFS/usr install
root:sh-utils-2.0# cd $LFS/usr/bin
root:bin# mv date echo false pwd stty $LFS/bin
root:bin# mv su true uname hostname $LFS/bin
```

---

## Contents

The Shellutils package contains the basename, chroot, date, dirname, echo, env, expr, factor, false, groups, hostid, hostname, id, logname, nice, nohup, pathchk, pinky, printenv, printf, pwd, seq, sleep, stty, su, tee, test, true, tty, uname, uptime, users, who, whoami and yes programs.

---

## Description

### basename

basename strips directory and suffixes from filenames.

---

### chroot

chroot runs a command or interactive shell with special root directory.

---

### date

date displays the current time in a specified format, or sets the system date.

---

### dirname

dirname strips non–directory suffixes from file name.

---

## **echo**

echo displays a line of text.

---

## **env**

env runs a program in a modified environment.

---

## **expr**

expr evaluates expressions.

---

## **factor**

factor prints the prime factors of all specified integer numbers.

---

## **false**

false always exits with a status code indicating failure.

---

## **groups**

groups prints the groups a user is in.

---

## **hostid**

hostid prints the numeric identifier (in hexadecimal) for the current host.

---

## **hostname**

hostname sets or prints the name of the current host system

---

## **id**

id prints the real and effective UIDs and GIDs of a user or the current user.

---

## **logname**

logname prints the current user's login name.

---

## **nice**

nice runs a program with modified scheduling priority.

---

## **nohup**

nohup runs a command immune to hangups, with output to a non-tty

---

## **pathchk**

pathchk checks whether file names are valid or portable.

---

## **pinky**

pinky is a lightweight finger utility which retrieves information about a certain user

---

## **printenv**

printenv prints all or part of the environment.

---

## **printf**

printf formats and print data (the same as the printf C function).

---

## **pwd**

pwd prints the name of the current/working directory

---

## **seq**

seq prints numbers in a certain range with a certain increment.

---

## **sleep**

sleep delays for a specified amount of time.

---

## **stty**

stty changes and prints terminal line settings.

---

## **su**

su runs a shell with substitute user and group IDs

---

## **tee**

tee reads from standard input and write to standard output and files.

---

## **test**

test checks file types and compares values.

---

## **true**

True always exitx with a status code indicating success.

---

## **tty**

tty prints the file name of the terminal connected to standard input.

---

## **uname**

uname prints system information.

---

## **uptime**

uptime tells how long the system has been running.

---

## **users**

users prints the user names of users currently logged in to the current host.

---

## **who**

who shows who is logged on.

---

## **whoami**

whoami prints your effective userid.

---

## **yes**

yes outputs a string repeatedly until killed.

---

# Installing Tar

## Installation of Tar

Install Tar by running the following commands:

```
root:tar-1.13# ./configure --prefix=/usr --disable-nls
root:tar-1.13# make LDFLAGS=-static
root:tar-1.13# make prefix=$LFS/usr install
root:tar-1.13# mv $LFS/usr/bin/tar $LFS/bin
```

---

## Contents

The tar package contains the tar and rmt programs.

---

## Description

### tar

tar is an archiving program designed to store and extract files from an archive file known as a tarfile.

---

### rmt

rmt is a program used by the remote dump and restore programs in manipulating a magnetic tape drive through an interprocess communication connection.

---

# Installing Textutils

## Installation of Textutils

Install Textutils by running the following commands:

```
root:textutils-2.0# ./configure --prefix=/usr --disable-nls
root:textutils-2.0# make LDFLAGS=-static
root:textutils-2.0# make prefix=$LFS/usr install
root:textutils-2.0# mv $LFS/usr/bin/cat $LFS/bin
```

---

## Contents

The Textutils package contains the cat, cksum, comm, split, cut, expand, fmt, fold, head, join, md5sum, nl, od, paste, pr, ptx, sort, split, sum, tac, tail, tr, tsort, unexpand, uniq and wc programs.

---

## Description

### cat

cat concatenates file(s) or standard input to standard output.

---

### cksum

cksum prints CRC checksum and byte counts of each specified file.

---

### comm

comm compares two sorted files line by line.

---

### csplit

csplit outputs pieces of a file separated by (a) pattern(s) to files xx01, xx02, ..., and outputs byte counts of each piece to standard output.

---

## **cut**

cut prints selected parts of lines from specified files to standard output.

---

## **expand**

expand converts tabs in files to spaces, writing to standard output.

---

## **fmt**

fmt reformats each paragraph in the specified file(s), writing to standard output.

---

## **fold**

fold wraps input lines in each specified file (standard input by default), writing to standard output.

---

## **head**

Print first xx (10 by default) lines of each specified file to standard output.

---

## **join**

join joins lines of two files on a common field.

---

## **md5sum**

md5sum prints or checks MD5 checksums.

---

## **nl**

nl writes each specified file to standard output, with line numbers added.

---

## **od**

od writes an unambiguous representation, octal bytes by default, of a specified file to standard output.

---

## **paste**

paste writes lines consisting of the sequentially corresponding lines from each specified file, separated by TABs, to standard output.

---

## **pr**

pr paginates or columnates files for printing.

---

## **ptx**

ptx produces a permuted index of file contents.

---

## **sort**

sort writes sorted concatenation of files to standard output.

---

## **split**

split outputs fixed-size pieces of an input file to PREFIXaa, PREFIXab, ...

---

## **sum**

sum prints checksum and block counts for each specified file.

---

## **tac**

tac writes each specified file to standard output, last line first.

---

## **tail**

tail print the last xx (10 by default) lines of each specified file to standard output.

---

## **tr**

tr translates, squeezes, and/or deletes characters from standard input, writing to standard output.

---

## **tsort**

tsort writes totally ordered lists consistent with the partial ordering in specified files.

---

## **unexpand**

unexpand converts spaces in each file to tabs, writing to standard output.

---

## **uniq**

uniq discards all but one of successive identical lines from files or standard input and writes to files or standard output.

---

## **wc**

wc prints line, word, and byte counts for each specified file, and a total line if more than one file is specified.

---

# Creating passwd and group files

In order for user and group root to be recognized and to be able to logon it needs an entry in the `/etc/passwd` and `/etc/group` file. Besides the group root a couple of other groups are recommended and needed by packages. The groups with their GID's below aren't part of any standard. The LSB only recommends besides a group root a group bin to be present with GID 1. Other group names and GID's can be chosen by yourself. Well written packages don't depend on GID numbers but just use the group name, it doesn't matter all that much what GID a group has. Since there aren't any standards for groups I won't follow any conventions used by Debian, RedHat and others. The groups added here are the groups the MAKEDEV script (the script that creates the device files in the `/dev` directory) mentions.

Create a new file `$LFS/etc/passwd` by running the following command:

```
root:~# echo "root:x:0:0:root:/root:/bin/bash" >
$LFS/etc/passwd
```

Create a new file `$LFS/etc/group` by running the following command:

```
root:~# echo "root:x:0:" > $LFS/etc/group
root:~# echo "bin:x:1:" >> $LFS/etc/group
root:~# echo "sys:x:2:" >> $LFS/etc/group
root:~# echo "kmem:x:3:" >> $LFS/etc/group
root:~# echo "tty:x:4:" >> $LFS/etc/group
root:~# echo "uucp:x:5:" >> $LFS/etc/group
root:~# echo "daemon:x:6:" >> $LFS/etc/group
root:~# echo "floppy:x:7:" >> $LFS/etc/group
root:~# echo "disk:x:8:" >> $LFS/etc/group
```

---

# Copying /proc/devices

In order for the MAKEDEV script properly create device entries in /dev it needs access to /proc/devices. We can't mount the proc file system on our LFS system yet so instead we just copy the /proc/devices file to \$LFS/proc. This means the \$LFS/proc/devices file won't be updated when the kernel updates /proc/devices but I don't see any harm in doing it, since it's only needed during the execution of the MAKEDEV script. Just make sure you don't add or remove any hardware during the next 3 minutes by loading or unloading a kernel module or rebooting your computer before continuing with this book.

Copy the /proc/devices file by running the following command:

```
root:~# cp /proc/devices $LFS/proc
```

---

# Chapter 6. Installing basic system software

# Introduction

The installation of all the software is pretty straightforward and you'll think it's so much easier and shorter to give the generic installation instructions for each package and only explain how to install something if a certain package requires an alternate installation method. Although I agree with you on that, I, however, choose to give the full instructions for each and every package. This is simply to avoid any possible confusion and errors.

---

# Debugging symbols and compiler optimizations

Most programs and libraries by default are compiled with debugging symbols and optimizing level 2 (gcc options `-g` and `-O2`) and are compiled for a specific CPU. On Intel platforms software is compiled for i386 processors by default. If you don't wish to run software on other machines other than your own, you might want to change the default compiler options so that they will be compiled with a higher optimization level, no debugging symbols and generate code for your specific architecture. Let me first explain what debugging symbols are.

A program compiled with debugging symbols means you can run a program or library through a debugger and the debugger's output will be user friendlier. These debugging symbols also enlarge the program or library significantly.

To remove debugging symbols from a binary (must be an a.out or ELF binary) run **strip** `--strip-debug filename` You can use wild cards if you need to strip debugging symbols from multiple files (use something like `strip --strip-debug $LFS/usr/bin/*`). Another, easier, options is just not to compile programs with debugging symbols. Most people will probably never use a debugger on software, so by leaving those symbols out you can save a lot of disk space.

Before you wonder if these debugging symbols would make a big difference, here are some statistics:

- A dynamic Bash binary with debugging symbols: 1.2MB
- A dynamic Bash binary without debugging symbols: 478KB
- `/lib` and `/usr/lib` (glibc and gcc files) with debugging symbols: 87MB
- `/lib` and `/usr/lib` (glibc and gcc files) without debugging symbols: 16MB

Sizes may vary depending on which compiler was used and which C library version was used to link dynamic programs against, but your results will be similar if you compare programs with and without debugging symbols. After I was done with this chapter and stripped all debugging symbols from all LFS binaries and libraries I regained a little over 102 MB of disk space. Quite the difference.

There are a few ways to change the default compiler options. One way is to edit every Makefile file you can find in a package, look for the `CFLAGS` and `CXXFLAGS` variables (a well designed package uses the `CFLAGS` variable to define gcc compiler options and `CXXFLAGS` to define g++ compiler options) and change their values. Packages like `binutils`, `gcc`, `glibc` and others have a lot of Makefile files in a lot of subdirectories so this would take a lot of time to do. Instead there's an easier way to do things: create the `CFLAGS` and `CXXFLAGS` environment variables. Most configure scripts read the `CFLAGS` and `CXXFLAGS` variables and use them in the Makefile files. A few packages don't follow this convention and those package require manual editing.

In the next section we'll create the `$LFS/root/.bash_profile` that will contain the following optimization:

```
CFLAGS="-O3 -mcpu=xxx -march=xxx"  
CXXFLAGS=$CFLAGS
```

This is a minimal set of optimizations that ensures it works on almost all platforms. These two options (`mcpu` and `march`) will compile the binaries with specific instructions for that CPU you have specified. This means you can't copy this binary to a lower class CPU and execute it. It will either work very unreliable or not at all (it will give errors like Illegal Instruction, core dumped). You'll have to read the GCC Info page to find more possible optimization flags. In the above environment variable you have to replace `xxx` and `yyy` with the appropriate CPU identifiers such as `i586`, `i686`, `powerpc` and others.

Please keep in mind that if you find that a package doesn't compile and gives errors like "segmentation fault, core dumped" it's most likely got to do with these compiler optimizations. Try lowering the optimizing level by changing `-O3` to `-O2`. If that doesn't work try `-O` or leave it out all together. Also try changing the `-mcpu` and `-march` variables. Compilers are very sensitive to certain hardware too. Bad memory can cause compilation problems when a high level of optimization is used, like the `-O3` setting. The fact that I don't have any problems compiling everything with `-O3` doesn't mean you won't have any problems either. Another problem can be the Binutils version that's installed on your system which often causes compilation problems in Glibc (most noticable in RedHat because RedHat often uses beta software which aren't always very stable. "RedHat likes living on the bleeding edge, but leaves the bleeding up to you" (quoted from somebody on the `lfs-discuss` mailinglist).

---

# Creating `$LFS/root/.bash_profile`

When we have entered the chroot'ed environment in the next section we want to export a couple of environment variables in that shell such as `TERM`, `CFLAGS`, `CXXFLAGS` and others variables you want to have set. For that purpose we'll create the `$LFS/root/.bash_profile` file and "source" it after we have entered the chroot'ed environment.

Create a new file `$LFS/root/.bash_profile` containing the following. Replace `-mcpu=xxx` and `-march=yyy` with the proper values for your machine:

```
# Begin /root/.bash_profile
TERM=linux
CFLAGS="-O3 -mcpu=xxx -march=yyy"
CXXFLAGS=$CFLAGS
export TERM CFLAGS CXXFLAGS
# End /root/.bash_profile
```

You can add more environment variables at your own discretion as you deem them necessary.

---

# Entering the chroot'ed environment

It's time to enter our chroot'ed environment in order to install the rest of the software we need.

Enter the following command to enter the chroot'ed environment. From this point on there's no need to use the `$LFS` variable anymore, because everything you do will be restricted to the LFS partition (since `/` is actually `/mnt/lfs` but the shell doesn't know that).

```
root:~# cd $LFS
root:lfs# chroot $LFS env -i HOME=/root bash --login
```

Now that we are inside a chroot'ed environment, we can continue to install all the basic system software. Make sure you execute all the following commands in this chapter from within the chroot'ed environment.

---

# Creating device files

## Installation of MAKEDEV

Install MAKEDEV by running the following commands:

```
root:MAKEDEV-2.5# sed "s/# 9/9/" MAKEDEV >/dev/MAKEDEV
root:MAKEDEV-2.5# chmod 754 /dev/MAKEDEV
```

---

## Creating the /dev entries

Create the device files by running the following commands:

```
root:~# cd /dev
root:dev# ./MAKEDEV -v generic
```

Now that the device file entries are created the /proc/devices file can be removed by running the following command:

```
root:~# rm /proc/devices
```

Please note that this script dates back from 1997 and therefore can be outdated and not support newer hardware. If you need device files which aren't known by this script please read the Documentation/devices.txt file in a Linux source tree. This file lists all the major and minor numbers for all the device files that the kernel knows about. With this list you can create such device files yourself. See the mknod man page for more information on how to make device files yourself.

---

# Installing GCC

## Installation of GCC

After you unpacked the gcc-2.95.2 archive don't enter the newly created gcc-2.95.2 directory but stay in the /usr/src directory. Install GCC by running the following commands:

```
root:src# mkdir /usr/src/gcc-build
root:src# cd /usr/src/gcc-build
root:gcc-build# ../gcc-2.95.2/configure --prefix=/usr \
> --with-gxx-include-dir=/usr/include/g++ \
> --enable-shared --enable-languages=c,c++
root:gcc-build# make bootstrap
root:gcc-build# make install
```

---

## Contents

The GCC package contains compilers, preprocessors and the GNU C++ Library.

---

## Description

### Compiler

A compiler translates source code in text format to a format that a computer understands. After a source code file is compiled into an object file, a linker will create an executable file from one or more of these compiler generated object files.

---

### Pre-processor

A pre-processor pre-processes a source file, such as including the contents of header files into the source file. You generally don't do this yourself to save yourself a lot of time. You just insert a line like #include <filename>. The pre-processor file insert the contents of that file into the source file. That's one of the things a pre-processor does.

---

### C++ Library

The C++ library is used by C++ programs. The C++ library contains functions that are frequently used in C++ programs. This way the programmer doesn't have to write certain functions (such as writing a string of text to the screen) from scratch every time he creates a program.

---

# Installing Bison

## Installation of Bison

Install Bison by running the following commands:

```
root:bison-1.28# ./configure --prefix=/usr \  
> --datadir=/usr/share/bison  
root:bison-1.28# make  
root:bison-1.28# make install
```

---

## Contents

The Bison package contains the bison program.

---

## Description

Bison is a parser generator, a replacement for YACC. YACC stands for Yet Another Compiler Compiler. What is Bison then? It is a program that generates a program that analyses the structure of a textfile. Instead of writing the actual program you specify how things should be connected and with those rules a program is constructed that analyses the textfile.

There are a lot of examples where structure is needed and one of them is the calculator.

Given the string :

$$1 + 2 * 3$$

You can easily come to the result 7. Why ? Because of the structure. You know how to interpret the string. The computer doesn't know that and Bison is a tool to help it understand by presenting the string in the following way to the compiler:

$$\begin{array}{c} + \\ / \backslash \\ * \quad 1 \\ / \backslash \\ 2 \quad 3 \end{array}$$

You start at the bottom of a tree and you come across the numbers 2 and 3 which are joined by the

multiplication symbol, so the computer multiplies 2 and 3. The result of that multiplication is remembered and the next thing that the computer sees is the result of  $2*3$  and the number 1 which are joined by the add symbol. Adding 1 to the previous result makes 7. In calculating the most complex calculations can be broken down in this tree format and the computer just starts at the bottom and works its way up to the top and comes with the correct answer. Of course, Bison isn't only used for calculators alone.

---

# Installing Mawk

## Installation of Mawk

Install Mawk by running the following commands:

```
root:mawk-1.3.3# ./configure
root:mawk-1.3.3# make
root:mawk-1.3.3# make BINDIR=/usr/bin \
> MANDIR=/usr/share/man/man1 install
root:mawk-1.3.3# cd /usr/bin
root:bin# ln -s mawk awk
```

---

## Contents

The Mawk package contains the mawk program.

---

## Description

### **gawk**

Mawk is an interpreter for the AWK Programming Language. The AWK language is useful for manipulation of data files, text retrieval and processing, and for prototyping and experimenting with algorithms.

---

# Installing Patch

## Installation of Patch

Install Patch by running the following commands:

```
root:patch-2.5.4# ./configure --prefix=/usr
root:patch-2.5.4# make
root:patch-2.5.4# make install
```

---

## Contents

The Patch package contains the patch program.

---

## Description

The patch program modifies a file according to a patch file. A patch file usually is a list created by the diff program that contains instructions on how an original file needs to be modified. Patch is used a lot for source code patches since it saves time and space. Imagine you have a package that is 1MB in size. The next version of that package only has changes in two files of the first version. You can ship an entirely new package of 1MB or provide a patch file of 1KB which will update the first version to make it identical to the second version. So if you have downloaded the first version already, a patch file can save you a second large download.

---

# Installing Findutils

## Installing Findutils

This package is known to cause compilation problem. If you're having trouble compiling this package as well, apply the Findutils patch.

Install this patch by running the following command:

```
root:findutils-4.1# patch -Np1 -i ../findutils-4.1.patch
```

Install Findutils by running the following commands:

```
root:findutils-4.1# ./configure --prefix=/usr
root:findutils-4.1# make
root:findutils-4.1# make install
```

---

## Contents

The Findutils package contains the find, locate, updatedb and xargs programs.

---

## Description

### Find

The find program searches for files in a directory hierarchy which match a certain criteria. If no criteria is given, it lists all files in the current directory and it's subdirectories.

---

### Locate

Locate scans a database which contain all files and directories on a filesystem. This program lists the files and directories in this database matching a certain criteria. If you're looking for a file this program will scan the database and tell you exactly where the files you requested are located. This only makes sense if your locate database is fairly up-to-date else it will provide you with out-of-date information.

---

## Updatedb

The updatedb program updates the locate database. It scans the entire file system (including other file systems that are currently mounted unless you specify it not to) and puts every directory and file it finds into the database that's used by the locate program which retrieves this information. It's a good practice to update this database once a day so that you are ensured of a database that is up-to-date.

---

## Xargs

The xargs command applies a command to a list of files. If you need to perform the same command on multiple files, you can create a file that contains all these files (one per line) and use xargs to perform that command on the list.

---

# Installing Ncurses

## Installation of Ncurses

Install Ncurses by running the following commands:

```
root:ncurses-5.1# ./configure --prefix=/usr --libdir=/lib \  
> --with-shared --disable-termcap  
root:ncurses-5.1# make  
root:ncurses-5.1# make install
```

---

## Contents

The Ncurses package contains the ncurses, panel, menu and form libraries. It also contains the tic, infocmp, clear, tput, toe and tset programs.

---

## Description

### The libraries

The libraries that make up the Ncurses library are used to display text (often in a fancy way) on your screen. An example where ncurses is used is in the kernel's "make menuconfig" process. The libraries contain routines to create panels, menu's, form and general text display routines.

---

### Tic

Tic is the terminfo entry-description compiler. The program translates a terminfo file from source format into the binary format for use with the ncurses library routines. Terminfo files contain information about the capabilities of your terminal.

---

### Infocmp

The infocmp program can be used to compare a binary terminfo entry with other terminfo entries, rewrite a terminfo description to take advantage of the use= terminfo field, or print out a terminfo description from the binary file (term) in a variety of formats (the opposite of what tic does).

---

## **clear**

The clear program clears your screen if this is possible. It looks in the environment for the terminal type and then in the terminfo database to figure out how to clear the screen.

---

## **tput**

The tput program uses the terminfo database to make the values of terminal–dependent capabilities and information available to the shell, to initialize or reset the terminal, or return the long name of the requested terminal type.

---

## **toe**

The toe program lists all available terminal types by primary name with descriptions.

---

## **tset**

The Tset program initializes terminals so they can be used, but it's not widely used anymore. It's provided for 4.4BSD compatibility.

---

# Installing Less

## Installation of Less

Install Less by running the following commands:

```
root:less-358# ./configure --prefix=/usr
root:less-358# make
root:less-358# make install
root:less-358# mv /usr/bin/less /bin
```

---

## Contents

The Less package contains the less program

---

## Description

The less program is a file pager (or text viewer). It displays the contents of a file with the ability to scroll. Less is an improvement on the common pager called "more". Less has the ability to scroll backwards through files as well and it doesn't need to read the entire file when it starts, which makes it faster when you are reading large files.

---

# Installing Groff

## Installation of Groff

Install Groff by running the following commands:

```
root@groff-1.16# ./configure --prefix=/usr
root@groff-1.16# make
root@groff-1.16# make install
```

---

## Contents

The Groff packages contains the addftinfo, afmtodit, eqn, grodvi, groff, grog, grohtml, grolj4, grops, grotty, hpfodit, indxbib, lkbib, lookbib, neqn, nroff, pfbtops, pic, psbb, refer, soelim, tbl, tfmtodit and troff programs.

---

## Description

### addftinfo

addftinfo reads a troff font file and adds some additional font-metric information that is used by the groff system.

---

### afmtodit

afmtodit creates a font file for use with groff and grops.

---

### eqn

eqn compiles descriptions of equations embedded within troff input files into commands that are understood by troff.

---

### grodvi

grodvi is a driver for groff that produces TeX dvi format.

---

## **groff**

groff is a front-end to the groff document formatting system. Normally it runs the troff program and a postprocessor appropriate for the selected device.

---

## **grog**

grog reads files and guesses which of the groff options `-e`, `-man`, `-me`, `-mm`, `-ms`, `-p`, `-s`, and `-t` are required for printing files, and prints the groff command including those options on the standard output.

---

## **grohtml**

grohtml translates the output of GNU troff to html

---

## **grolj4**

grolj4 is a driver for groff that produces output in PCL5 format suitable for an HP Laserjet 4 printer.

---

## **grops**

grops translates the output of GNU troff to PostScript.

---

## **grotty**

grotty translates the output of GNU troff into a form suitable for typewriter-like devices.

---

## **hpftodit**

hpftodit creates a font file for use with groff `-Tlj4` from an HP tagged font metric file.

---

## **indxbib**

indxbib makes an inverted index for the bibliographic databases a specified file for use with refer, lookbib, and lkbib.

---

## **lkbib**

lkbib searches bibliographic databases for references that contain specified keys and prints any references found on the standard output.

---

## **lookbib**

lookbib prints a prompt on the standard error (unless the standard input is not a terminal), reads from the standard input a line containing a set of keywords, searches the bibliographic databases in a specified file for references containing those keywords, prints any references found on the standard output, and repeats this process until the end of input.

---

## **neqn**

It is currently not known what neqn is and what it does.

---

## **nroff**

The nroff script emulates the nroff command using groff.

---

## **pfbtops**

pfbtops translates a PostScript font in .pfb format to ASCII.

---

## **pic**

pic compiles descriptions of pictures embedded within troff or TeX input files into commands that are understood by TeX or troff.

---

## **psbb**

psbb reads a file which should be a PostScript document conforming to the Document Structuring conventions and looks for a %%BoundingBox comment.

---

## **refer**

refer copies the contents of a file to the standard output, except that lines between .[ and .] are interpreted as citations, and lines between .R1 and .R2 are interpreted as commands about how citations are to be processed.

## **soelim**

soelim reads files and replaces lines of the form *.so file* by the contents of *file*.

---

## **tbl**

tbl compiles descriptions of tables embedded within troff input files into commands that are understood by troff.

---

## **tfmtoedit**

tfmtoedit creates a font file for use with **groff -Tdvi**

---

## **troff**

troff is highly compatible with Unix troff. Usually it should be invoked using the groff command, which will also run preprocessors and postprocessors in the appropriate order and with the appropriate options.

---

# Installing Man

## Installation of Man

Install Man by running the following commands:

```
root:man-1.5h1# ./configure -default
root:man-1.5h1# make
root:man-1.5h1# make install
```

---

## Contents

The Man package contains the man, apropos whatis and makewhatis programs.

---

## Description

### man

man formats and displays the on-line manual pages.

---

### apropos

apropos searches a set of database files containing short descriptions of system commands for keywords and displays the result on the standard output.

---

### whatis

whatis searches a set of database files containing short descriptions of system commands for keywords and displays the result on the standard output. Only complete word matches are displayed.

---

### makewhatis

makewhatis reads all the manual pages contained in given sections of manpath or the preformatted pages contained in the given sections of catpath. For each page, it writes a line in the whatis database; each line consists of the name of the page and a short description, separated by a dash. The description is extracted using the content of the NAME section of the manual page.

---

# Installing Perl

## Installation of Perl

Install Perl by running the following commands:

```
root:perl-5.6.0# ./Configure -Dprefix=/usr
root:perl-5.6.0# make
root:perl-5.6.0# make test
root:perl-5.6.0# make install
```

If you don't want to answer all those questions Perl asks you, you can add the `-d` option to the configure script and Perl will use all the default settings.

Also note that a few tests during the `make test` phase will fail for various reasons. One being there's not network support yet and a few packages haven't been installed yet. It's ok if not every test succeeds. If there are between 5 and 10 failed tests you're just fine. You might want to reinstall perl after you're done with chapter 7.

---

## Contents

The Perl package contains Perl – Practical Extraction and Report Language

---

## Description

Perl combines the features and capabilities of C, awk, sed and sh into one powerful programming language.

---

# Installing M4

## Installation of M4

Install M4 by running the following commands:

```
root:m4-1.4# ./configure --prefix=/usr
root:m4-1.4# make
root:m4-1.4# make install
```

If your base system is running a 2.0 kernel and your Glibc version is 2.1 then you will most likely get problems executing M4 in the chroot'ed environment due to incompatibilities between the M4 program, Glibc-2.1 and the running 2.0 kernel. If you have problems executing the m4 program in the chroot'ed environment (for example when you install the autoconf and automake packages) you'll have to exit the chroot'ed environment and compile M4 statically. This way the binary is linked against Glibc 2.0 (if you run kernel 2.0 your Glibc version is 2.0 as well on a decent system. Kernel 2.0 and Glibc-2.1 don't mix very well) and won't give you any problems.

To create a statically linked version of M4, execute the following commands:

```
root:m4-1.4# logout
root:lfs# cd $LFS/usr/src/m4-1.4
root:m4-1.4# ./configure --prefix=/usr --disable-nls
root:m4-1.4# make LDFLAGS=-static
root:m4-1.4# make prefix=$LFS/usr install
root:m4-1.4# chroot $LFS env -i HOME=/root bash --login
```

Now you can re-enter the chroot'ed environment and continue with the next package. If you wish to recompile M4 dynamically, you can do that after you have rebooted into the LFS system rather than chroot'ed into it.

---

## Contents

The M4 package contains the M4 processor

---

## Description

M4 is a macro processor. It copies input to output expanding macros as it goes. Macros are either builtin or user-defined and can take any number of arguments. Besides just doing macro expansion m4 has builtin functions for including named files, running UNIX commands, doing integer arithmetic, manipulating text in various ways, recursion, etc. M4 can be used either as a front-end to a compiler or as a macro processor in its

own right.

---

# Installing Texinfo

## Installation of Texinfo

Install Texinfo by running the following commands:

```
root:texinfo-4.0# ./configure --prefix=/usr
root:texinfo-4.0# make
root:texinfo-4.0# make install
```

---

## Contents

The Texinfo package contains the info, install-info, makeinfo, texi2dvi and texindex programs

---

## Description

### info

The info program reads Info documents, usually contained in your /usr/doc/info directory. Info documents are like man(ual) pages, but they tend to be more in depth than just explaining the options to a program.

---

### install-info

The install-info program updates the info entries. When you run the info program a list with available topics (ie: available info documents) will be presented. The install-info program is used to maintain this list of available topics. If you decide to remove info files manually, you need to delete the topic in the index file as well. This program is used for that. It also works the other way around when you add info documents.

---

### makeinfo

The makeinfo program translates Texinfo source documents into various formats. Available formats are: info files, plain text and HTML.

---

### texi2dvi

The texi2dvi program prints Texinfo documents

---

## **texindex**

The texindex program is used to sort Texinfo index files.

---

# Installing Autoconf

## Installation of Autoconf

Install Autoconf by running the following commands:

```
root:autoconf-2.13# ./configure --prefix=/usr
root:autoconf-2.13# make
root:autoconf-2.13# make install
```

---

## Contents

The Autoconf package contains the autoconf, autoheader, autoreconf, autoscan, autoupdate and ifnames programs

---

## Description

### autoconf

Autoconf is a tool for producing shell scripts that automatically configure software source code packages to adapt to many kinds of UNIX-like systems. The configuration scripts produced by Autoconf are independent of Autoconf when they are run, so their users do not need to have Autoconf.

---

### autoheader

The autoheader program can create a template file of C #define statements for configure to use

---

### autoreconf

If you have a lot of Autoconf-generated configure scripts, the autoreconf program can save you some work. It runs autoconf (and autoheader, where appropriate) repeatedly to remake the Autoconf configure scripts and configuration header templates in the directory tree rooted at the current directory.

---

### autoscan

The autoscan program can help you create a configure.in file for a software package. autoscan examines source files in the directory tree rooted at a directory given as a command line argument, or the current directory if none is given. It searches the source files for common portability problems and creates a file

configure.scan which is a preliminary configure.in for that package.

---

## **autoupdate**

The autoupdate program updates a configure.in file that calls Autoconf macros by their old names to use the current macro names.

---

## **ifnames**

ifnames can help when writing a configure.in for a software package. It prints the identifiers that the package already uses in C preprocessor conditionals. If a package has already been set up to have some portability, this program can help you figure out what its configure needs to check for. It may help fill in some gaps in a configure.in generated by autoscan.

---

# Installing Automake

## Installation of Automake

Install Automake by running the following commands:

```
root:automake-1.4# ./configure --prefix=/usr
root:automake-1.4# make install
```

---

## Contents

The Automake package contains the aclocal and automake programs

---

## Description

### aclocal

Automake includes a number of Autoconf macros which can be used in your package; some of them are actually required by Automake in certain situations. These macros must be defined in your aclocal.m4; otherwise they will not be seen by autoconf.

The aclocal program will automatically generate aclocal.m4 files based on the contents of configure.in. This provides a convenient way to get Automake-provided macros, without having to search around. Also, the aclocal mechanism is extensible for use by other packages.

---

### automake

To create all the Makefile.in's for a package, run the automake program in the top level directory, with no arguments. automake will automatically find each appropriate Makefile.am (by scanning configure.in) and generate the corresponding Makefile.in.

---

# Installing Bash

## Installation of Bash

Install Bash by running the following commands:

```
root:~# ./configure --prefix=/usr --with-ncurses
root:~# make
root:~# make install
root:~# logout
root:~# mv $LFS/usr/bin/bash $LFS/usr/bin/bashbug $LFS/bin
root:~# chroot $LFS env -i HOME=/root bash --login
```

---

## Contents

The Bash package contains the bash program

---

## Description

Bash is the Bourne–Again SHell, which is a widely used command interpreter on Unix systems. Bash is a program that reads from standard input, the keyboard. You type something and the program will evaluate what you have typed and do something with it, like running a program.

---

# Installing Flex

## Installation of Flex

Install Flex by running the following commands:

```
root:flex-2.5.4a# ./configure --prefix=/usr
root:flex-2.5.4a# make
root:flex-2.5.4a# make install
```

---

## Contents

The Flex package contains the flex program

---

## Description

Flex is a tool for generating programs which recognize patterns in text. Pattern recognition is very useful in many applications. You set up rules what to look for and flex will make a program that looks for those patterns. The reason people use flex is that it is much easier to set up rules for what to look for than to write the actual program that finds the text.

---

# Installing File

## Installation of File

Install File by running the following commands:

```
root:file-3.31# ./configure --prefix=/usr
--datadir=/usr/share/misc
root:file-3.31# make
root:file-3.31# make install
```

---

## Contents

The File package contains the file program.

---

## Description

File tests each specified file in an attempt to classify it. There are three sets of tests, performed in this order: filesystem tests, magic number tests, and language tests. The first test that succeeds causes the file type to be printed.

---

# Installing Libtool

## Installation of Libtool

Install Libtool by running the following commands:

```
root:libtool-1.3.5# ./configure --prefix=/usr
root:libtool-1.3.5# make
root:libtool-1.3.5# make install
```

---

## Contents

The Libtool package contains the libtool and libtoolize programs. It also contains the ltdl library.

---

## Description

### libtool

Libtool provides generalized library-building support services.

---

### libtoolize

libtoolize provides a standard way to add libtool support to your package.

---

### ltdl library

Libtool provides a small library, called `libltdl', that aims at hiding the various difficulties of dlopening libraries from programmers.

---

# Installing Bin86

## Installation of Bin86

Install Linux86 by running the following commands:

```
root:bin86# make
root:bin86# make PREFIX=/usr install
```

---

## Contents

The Bin86 contains the as86, as86\_encap, ld86, objdump86, nm86 and size86 programs.

---

## Description

### as86

as86 is an assembler for the 8086...80386 processors.

---

### as86\_encap

as86\_encap is a shell script to call as86 and convert the created binary into a C file prog.v to be included in or linked with programs like boot block installers.

---

### ld86

ld86 understands only the object files produced by the as86 assembler, it can link them into either an impure or a separate I&D executable.

---

### objdump86

No description available.

---

## **nm86**

No description available.

---

## **size86**

No description available.

---

# Installing Binutils

## Installation of Binutils

Install Binutils by running the following commands:

```
root:binutils-2.10# ./configure --prefix=/usr --enable-shared
root:binutils-2.10# make -e tooldir=/usr
root:binutils-2.10# make -e tooldir=/usr install
```

---

## Description

The Binutils package contains the ld, as, ar, nm, objcopy, objdump, ranlib, size, strings, strip, c++filt, addr2line and nlmconv programs

---

## Description

### ld

ld combines a number of object and archive files, relocates their data and ties up symbol references. Often the last step in building a new compiled program to run is a call to ld.

---

### as

as is primarily intended to assemble the output of the GNU C compiler gcc for use by the linker ld.

---

### ar

The ar program creates, modifies, and extracts from archives. An archive is a single file holding a collection of other files in a structure that makes it possible to retrieve the original individual files (called members of the archive).

---

### nm

nm lists the symbols from object files.

---

## **objcopy**

objcopy utility copies the contents of an object file to another. objcopy uses the GNU BFD Library to read and write the object files. It can write the destination object file in a format different from that of the source object file.

---

## **objdump**

objdump displays information about one or more object files. The options control what particular information to display. This information is mostly useful to programmers who are working on the compilation tools, as opposed to programmers who just want their program to compile and work.

---

## **ranlib**

ranlib generates an index to the contents of an archive, and stores it in the archive. The index lists each symbol defined by a member of an archive that is a relocatable object file.

---

## **size**

size lists the section sizes —and the total size— for each of the object files objfile in its argument list. By default, one line of output is generated for each object file or each module in an archive.

---

## **strings**

For each file given, strings prints the printable character sequences that are at least 4 characters long (or the number specified with an option to the program) and are followed by an unprintable character. By default, it only prints the strings from the initialized and loaded sections of object files; for other types of files, it prints the strings from the whole file.

strings is mainly useful for determining the contents of non-text files.

---

## **strip**

strip discards all or specific symbols from object files. The list of object files may include archives. At least one object file must be given. strip modifies the files named in its argument, rather than writing modified copies under different names.

---

## **c++filt**

The C++ language provides function overloading, which means that you can write many functions with the same name (providing each takes parameters of different types). All C++ function names are encoded into a low-level assembly label (this process is known as mangling). The `c++filt` program does the inverse mapping: it decodes (demangles) low-level names into user-level names so that the linker can keep these overloaded functions from clashing.

---

## **addr2line**

`addr2line` translates program addresses into file names and line numbers. Given an address and an executable, it uses the debugging information in the executable to figure out which file name and line number are associated with a given address.

---

## **nlmconv**

`nlmconv` converts relocatable object files into the NetWare Loadable Module files, optionally reading header files for NLM header information.

---

# Installing Bzip2

## Installation of Bzip2

Install Bzip2 by running the following commands:

```
root:bzip2-1.0.1# make -f Makefile-libbz2_so
root:bzip2-1.0.1# make bzip2recover libbz2.a
root:bzip2-1.0.1# cp bzip2-shared /bin/bzip2
root:bzip2-1.0.1# cp bzip2recover /bin
root:bzip2-1.0.1# cp bzip2.1 /usr/share/man/man1
root:bzip2-1.0.1# cp bzlib.h /usr/include
root:bzip2-1.0.1# cp -a libbz2.so* libbz2.a /lib
root:bzip2-1.0.1# rm /usr/lib/libbz2.a
root:bzip2-1.0.1# cd /bin
root:bin# rm bunzip2 && ln -s bzip2 bunzip2
root:bin# rm bzip2cat && ln -s bzip2 bzip2cat
root:bin# cd /usr/share/man/man1
root:man1# ln -s bzip2.1 bunzip2.1
root:man1# ln -s bzip2.1 bzip2cat.1
root:man1# ln -s bzip2.1 bzip2recover.1
```

Although it's not strictly a part of a basic LFS system it's worth mentioning that you can download a patch for Tar which enables the tar program to compress and uncompress using bzip2/bunzip2 easily. With a plain tar you'll have to use constructions like `bzip2 file.tar.bz2` or `tar --use-compress-prog=bunzip2 -xvf file.tar.bz2` to use bzip2 and bunzip2 with tar. This patch gives you the `-y` option so you can unpack a Bzip2 archive with `tar xvfy file.tar.bz2`. Applying this patch will be mentioned later on when you re-install the Tar package.

---

## Contents

The Bzip2 packages contains the bzip2, bunzip2, bzip2cat and bzip2recover programs.

---

## Description

### Bzip2

bzip2 compresses files using the Burrows–Wheeler block sorting text compression algorithm, and Huffman coding. Compression is generally considerably better than that achieved by more conventional LZ77/LZ78–based compressors, and approaches the performance of the PPM family of statistical compressors.

---

## **Bunzip2**

Bunzip2 decompresses files that are compressed with bzip2.

---

## **bzcat**

bzcat (or bzip2 -dc) decompresses all specified files to the standard output.

---

## **bzip2recover**

bzip2recover recovers data from damaged bzip2 files.

---

# Installing Gettext

## Installation of Gettext

Install Gettext by running the following commands:

```
root:gettext-0.10.35# ./configure --prefix=/usr
root:gettext-0.10.35# make
root:gettext-0.10.35# make install
root:gettext-0.10.35# mv /po-mode.el /usr/share/gettext
```

---

## Contents

The gettext package contains the gettext, gettextize, msgcmp, msgcomm, msgfmt, msgmerge, msgunfmt and xgettext programs.

---

## Description

### gettext

The gettext package is used for internationalization (also known as i18n) and for localization (also known as l10n). Programs can be compiled with Native Language Support (NLS) which enable them to output messages in your native language rather than in the default English language.

---

# Installing Consoletools

## Installation of Console-tools

Before you start installing Console-tools you have to unpack the console-tools-0.2.3.patch file.

Install Console-tools by running the following commands:

```
root:console-tools-0.2.3# patch -Np1 -i
../console-tools-0.2.3.patch
root:console-tools-0.2.3# ./configure --prefix=/usr
root:console-tools-0.2.3# make
root:console-tools-0.2.3# make install
```

---

## Contents

The Console-tools package contains the charset, chvt, consolechars, deallocvt, dumpkeys, fgconsole, fix\_bs\_and\_del, font2psf, getkeycodes, kbd\_mode, loadkeys, loadunimap, mapscrn, mk\_modmap, openvt, psfaddtable, psfgettable, psfstrietable, resizecons, saveunimap, screendump, setfont, setkeycodes, setleds, setmetamode, setvesablank, showcfont, showkey, splitfont, unicode\_start, unicode\_stop, vcstime, vt-is-URF8, writetv

---

## Description

### charset

charset sets an ACM for use in one of the G0/G1 charsets slots.

---

### chvt

chvt changes foreground virtual terminal.

---

### codepage

No description available.

---

## **consolechars**

consolechars loads EGA/VGA console screen fonts, screen font maps and/or application–charset maps.

---

## **deallocvt**

deallocvt deallocates unused virtual terminals.

---

## **dumpkeys**

dumpkeys dumps keyboard translation tables.

---

## **fgconsole**

fgconsole prints the number of the active virtual terminal.

---

## **fix\_bs\_and\_del**

No description available.

---

## **font2psf**

No description available.

---

## **getkeycodes**

getkeycodes prints the kernel scancode–to–keycode mapping table.

---

## **kbd\_mode**

kbd\_mode reports or sets the keyboard mode.

---

## **loadkeys**

loadkeys loads keyboard translation tables.

---

## **loadunimap**

No description available.

---

## **mapscrn**

No description available.

---

## **mk\_modmap**

No description available.

---

## **openvt**

openvt starts a program on a new virtual terminal.

---

## **psfaddtable**

psfaddtable adds a Unicode character table to a console font.

---

## **psfgettable**

psfgettable extracts the embedded Unicode character table from a console font.

---

## **psfstriptime**

psfstriptime removes the embedded Unicode character table from a console font.

---

## **resizecons**

resizecons changes the kernel idea of the console size.

---

## **saveunimap**

No description available.

---

## **screendump**

No description available.

---

## **setfont**

No description available.

---

## **setkeycodes**

setkeycodes loads kernel scancode-to-keycode mapping table entries.

---

## **setleds**

setleds sets the keyboard leds.

---

## **setmetamode**

setmetamode defines the keyboard meta key handling.

---

## **setvesablank**

No description available.

---

## **showcfont**

showcfont displays all character in the current screenfont.

---

## **showkey**

showkey examines the scancodes and keycodes sent by the keyboard.

---

## **splitfont**

No description available.

---

## **unicode\_start**

unicode\_start puts the console in Unicode mode.

---

## **unicode\_stop**

No description available.

---

## **vcstime**

No description available.

---

## **vt-is-UTF8**

vt-is-UTF8 checks whether the current virtual terminal is in UTF8- or byte-mode.

---

## **writetv**

No description available.

---

# Installing Consoledata

## Installation of Console-data

Replace <path-to-kmap-file> below with the correct path to the desired kmap.gz file. An example could be i386/qwerty/us.kmap.gz

Install Console-data by running the following commands:

```
root:console-data-1999.08.29# ./configure --prefix=/usr
root:console-data-1999.08.29# make
root:console-data-1999.08.29# make install
root:console-data-1999.08.29# cd /usr/share/keymaps
root:keymaps# ln -s <path-to-kmap-file> defkeymap.kmap.gz
```

---

## Contents

The console-data package contains the data files that are used and needed by the console-tools package.

---

# Installing Diffutils

## Installation of Diffutils

Install Diffutils by running the following commands:

```
root:diffutils-2.7# ./configure --prefix=/usr
root:diffutils-2.7# make
root:diffutils-2.7# make install
```

---

## Contents

The Diffutils package contains the `cmp`, `diff`, `diff3` and `sdiff` programs.

---

## Description

### `cmp` and `diff`

`cmp` and `diff` both compare two files and report their differences. Both programs have extra options which compare files in different situations.

---

### `diff3`

The difference between `diff` and `diff3` is that `diff` compares 2 files, `diff3` compares 3 files.

---

### `sdiff`

`sdiff` merges two two files and interactively outputs the results.

---

# Installing E2fsprogs

## Installation of E2fsprogs

Install E2fsprogs by running the following commands:

Please note that the empty `--with-root-prefix=` option below is supposed to be like this. I did not forget to supply a value there.

```
root:e2fsprogs-1.19# ./configure --prefix=/usr
--with-root-prefix= \
> --enable-elf-shlibs
root:e2fsprogs-1.19# make
root:e2fsprogs-1.19# make install
```

---

## Contents

The e2fsprogs package contains the `chattr`, `lsattr`, `uuidgen`, `badblocks`, `debugfs`, `dumpe2fs`, `e2fsck`, `e2label`, `fsck`, `fsck.ext2`, `mke2fs`, `mkfs.ext2`, `mklost+found` and `tune2fs` programs.

---

## Description

### **chattr**

`chattr` changes the file attributes on a Linux second extended file system.

---

### **lsattr**

`lsattr` lists the file attributes on a second extended file system.

---

### **uuidgen**

The `uuidgen` program creates a new universally unique identifier (UUID) using the `libuuid` library. The new UUID can reasonably be considered unique among all UUIDs created on the local system, and among UUIDs created on other systems in the past and in the future.

---

## **badblocks**

badblocks is used to search for bad blocks on a device (usually a disk partition).

---

## **debugfs**

The debugfs program is a file system debugger. It can be used to examine and change the state of an ext2 file system.

---

## **dumpe2fs**

dumpe2fs prints the super block and blocks group information for the filesystem present on a specified device.

---

## **e2fsck and fsck.ext2**

e2fsck is used to check a Linux second extended file system. fsck.ext2 does the same as e2fsck.

---

## **e2label**

e2label will display or change the filesystem label on the ext2 filesystem located on the specified device.

---

## **fsck**

fsck is used to check and optionally repair a Linux file system.

---

## **mke2fs and mkfs.ext2**

mke2fs is used to create a Linux second extended file system on a device (usually a disk partition). mkfs.ext2 does the same as mke2fs.

---

## **mklost+found**

mklost+found is used to create a lost+found directory in the current working directory on a Linux second extended file system. mklost+found pre-allocates disk blocks to the directory to make it usable by e2fsck.

---

## **tune2fs**

tune2fs adjusts tunable filesystem parameters on a Linux second extended filesystem.

---

# Installing Ed

## Installation of Ed

Install Ed by running the following commands:

```
root:ed-0.2# ./configure --prefix=/usr
root:ed-0.2# make
root:ed-0.2# make install
root:ed-0.2# mv /usr/bin/ed /usr/bin/red /bin
```

---

## Contents

The Ed package contains the ed program.

---

## Description

Ed is a line-oriented text editor. It is used to create, display, modify and otherwise manipulate text files.

---

# Installing Fileutils

## Installation of Fileutils

Install Fileutils by running the following commands:

```
root:fileutils-4.0# ./configure --prefix=/usr
root:fileutils-4.0# make
root:fileutils-4.0# make install
root:fileutils-4.0# cd /usr/bin
root:bin# mv chgrp chmod chown cp dd df dir /bin
root:bin# mv dircolors du install ln ls mkdir mkfifo /bin
root:bin# mv mknod rm rmdir sync touch vdir /bin
root:bin# cp mv /bin && rm mv
root:bin# ln -s ../../bin/install install
```

---

## Contents

The Fileutils package contains the chgrp, chmod, chown, cp, dd, df, dir, dircolors, du, install, ln, ls, mkdir, mkfifo, mknod, mv, rm, rmdir, sync, touch and vdir programs.

---

## Description

### chgrp

chgrp changes the group ownership of each given file to the named group, which can be either a group name or a numeric group ID.

---

### chmod

chmod changes the permissions of each given file according to mode, which can be either a symbolic representation of changes to make, or an octal number representing the bit pattern for the new permissions.

---

### chown

chown changes the user and/or group ownership of each given file.

---

## **cp**

cp copies files from one place to another.

---

## **dd**

dd copies a file (from the standard input to the standard output, by default) with a user-selectable blocksize, while optionally performing conversions on it.

---

## **df**

df displays the amount of disk space available on the filesystem containing each file name argument. If no file name is given, the space available on all currently mounted filesystems is shown.

---

## **ls, dir and vdir**

dir and vdir are versions of ls with different default output formats. These programs list each given file or directory name. Directory contents are sorted alphabetically. For ls, files are by default listed in columns, sorted vertically, if the standard output is a terminal; otherwise they are listed one per line. For dir, files are by default listed in columns, sorted vertically. For vdir, files are by default listed in long format.

---

## **dircolors**

dircolors outputs commands to set the LS\_COLOR environment variable. The LS\_COLOR variable is used to change the default color scheme used by ls and related utilities.

---

## **du**

du displays the amount of disk space used by each argument and for each subdirectory of directory arguments.

---

## **install**

install copies files and sets their permission modes and, if possible, their owner and group.

---

## **ln**

ln makes hard or soft (symbolic) links between files.

---

## **mkdir**

mkdir creates directories with a given name.

---

## **mkfifo**

mkfifo creates a FIFO with each given name.

---

## **mknod**

mknod creates a FIFO, character special file, or block special file with the given file name.

---

## **mv**

mv moves files from one directory to another or renames files, depending on the arguments given to mv.

---

## **rm**

rm removes files or directories.

---

## **rmdir**

rmdir removes directories, if they are empty.

---

## **sync**

sync forces changed blocks to disk and updates the super block.

---

## **touch**

touch changes the access and modification times of each given file to the current time. Files that do not exist are created empty.

---

# Installing Grep

## Installation of Grep

Install Grep by running the following commands:

```
root@grep-2.4.2# ./configure --prefix=/usr
root@grep-2.4.2# make
root@grep-2.4.2# make install
```

---

## Contents

The grep package contains the egrep, fgrep and grep programs.

---

## Description

### egrep

egrep prints lines from files matching an extended regular expression pattern.

---

### fgrep

fgrep prints lines from files matching a list of fixed strings, separated by newlines, any of which is to be matched.

---

### grep

grep prints lines from files matching a basic regular expression pattern.

---

# Installing Gzip

## Installation of Gzip

Install Gzip by running the following commands:

```
root:gzip-1.2.4a# ./configure --prefix=/usr
root:gzip-1.2.4a# make
root:gzip-1.2.4a# make install
root:gzip-1.2.4a# cd /usr/bin
root:bin# mv gzip /bin
root:bin# rm gunzip /bin/gunzip
root:bin# cd /bin
root:bin# ln -s gzip gunzip
```

---

## Contents

The Gzip package contains the gunzip, gzexe, gzip, zcat, zcmp, zdiff, zforce, zgrep, zmore and znew programs.

---

## Description

### gunzip

gunzip decompresses files that are compressed with gzip.

---

### gzexe

gzexe allows you to compress executables in place and have them automatically uncompress and execute when you run them (at a penalty in performance).

---

### gzip

gzip reduces the size of the named files using Lempel–Ziv coding (LZ77).

---

## **zcat**

zcat uncompresses either a list of files on the command line or its standard input and writes the uncompressed data on standard output

---

## **zcmp**

zcmp invokes the cmp program on compressed files.

---

## **zdiff**

zdiff invokes the diff program on compressed files.

---

## **zforce**

zforce forces a .gz extension on all gzip files so that gzip will not compress them twice. This can be useful for files with names truncated after a file transfer.

---

## **zgrep**

zgrep invokes the grep program on compressed files.

---

## **zmore**

Zmore is a filter which allows examination of compressed or plain text files one screenful at a time on a soft-copy terminal (similar to the more program).

---

## **znew**

Znew recompresses files from .Z (compress) format to .gz (gzip) format.

---

# Installing Ldso

## Installation of Ld.so

Install Ld.so by running the following commands:

```
root:ld.so-1.9.9# cd util
root:util# make ldd ldconfig
root:util# cp ldd /bin
root:util# cp ldconfig /sbin
root:util# cd ../man
root:man# cp ldd.1 /usr/share/man/man1
root:man# cp *.8 /usr/share/man/man8
root:man# rm /usr/bin/ldd
root:man# hash -r
```

The "hash -r" command is to make bash forget about the locations of previously executed commands. If you have executed ldd before, bash expects it to be found in /usr/bin. Since we moved it to /bin, the cache needs to be purged so bash can find it in /bin when you want to execute it again.

You might have noticed that we don't use the compiler optimizations for this package. The reason is that overriding the CFLAGS variable causes compilation problems. You would have to edit the Config.mk file and add the proper values to the CFLAGS variable and then compile the package. If you want to do that it's up to you. I don't think it's worth the trouble though. The ld and ldd programs usually are only rarely used.

---

## Contents

From the Ld.so package we're using the ldconfig and ldd programs.

---

## Description

### ldconfig

ldconfig creates the necessary links and cache (for use by the run-time linker, ld.so) to the most recent shared libraries found in the directories specified on the command line, in the file /etc/ld.so.conf, and in the trusted directories (/usr/lib and /lib). ldconfig checks the header and file names of the libraries it encounters when determining which versions should have their links updated.

---

## **ldd**

ldd prints the shared libraries required by each program or shared library specified on the command line.

---

# Installing Vim

## Installation of Vim

You need to unpack both the vim-rt and vim-src packages to install Vim. Both packages will unpack their files into the vim-5.7 directory. This won't overwrite any files from the other package. So it doesn't matter in which order you do it. Install Vim by running the following commands:

```
root:vim-5.7# ./configure --prefix=/usr
root:vim-5.7# make
root:vim-5.7# make install
root:vim-5.7# cd /usr/bin
root:bin# ln -s vim vi
```

If you are planning on installing the X Window system on your LFS system, you might want to re-compile Vim after you have installed X. Vim comes with a nice GUI version of the editor which requires X and a few other libraries to be installed. For more information read the Vim documentation.

---

## Contents

The Vim package contains the ctags, etags, ex, gview, gvim, rgview, rgvim, rview, rvim, view, vim, vintutor and xxd programs.

---

## Description

### ctags

ctags generate tag files for source code.

---

### etags

etags does the same as ctags but it can generate cross reference files which list information about the various source objects found in a set of language files.

---

### ex

ex starts vim in Ex mode.

---

## **gview**

gview is the GUI version of view.

---

## **gvim**

gvim is the GUI version of vim.

---

## **rgview**

rgview is teh GUI version of rview.

---

## **rgvim**

rgvim is the GUI version of rvim.

---

## **rview**

rview is a restricted version of view. No shell commands can be started and Vim can't be suspended.

---

## **rvim**

rvim is the restricted version of vim. No shell commands can be started and Vim can't be suspended.

---

## **view**

view starts vim in read-only mode.

---

## **vim**

vim starts vim in the normal, default way.

---

## **vimtutor**

vimtutor starts the Vim tutor.

---

## **xxd**

xxd makes a hexdump or does the reverse.

---

# Installing Lilo

## Installation of Lilo

Edit the `Makefile` file and edit the `CFLAGS` variable if you want to add compiler optimization to this package.

Install Lilo by running the following commands:

```
root:lilo-21.5# make
root:lilo-21.5# make install
```

It appears that compilation of this package fails on certain machines when the `-g` compiler flag is being used. If you can't compile Lilo at all, please try removing the `-g` value from the `CFLAGS` variable in the `Makefile` file.

At the end of the installation the `make install` process will print a message stating that you have to execute `/sbin/lilo` to complete the update. Don't do this as it has no use. The `/etc/lilo.conf` isn't present yet. We will complete the installation of lilo in chapter 8.

---

## Contents

The Lilo package contains the lilo program.

---

## Description

lilo installs the Linux boot loader which is used to start a Linux system.

---

# Installing Make

## Installation of Make

Install Make by running the following commands:

```
root:make-3.79.1# ./configure --prefix=/usr
root:make-3.79.1# make
root:make-3.79.1# make install
```

---

## Contents

The Make package contains the make program.

---

## Description

make determine automatically which pieces of a large program need to be recompiled, and issue the commands to recompile them.

---

# Installing Modutils

## Installation of Modutils

Install Modutils by running the following commands:

```
root:modutils-2.3.13# ./configure
root:modutils-2.3.13# make
root:modutils-2.3.13# make install
```

---

## Contents

The Modutils package contains the depmod, genksyms, insmod, insmod\_ksymoops\_clean, kerneld, kernelversion, ksyms, lsmod, modinfo, modprobe and rmmod programs.

---

## Description

### depmod

depmod handles dependency descriptions for loadable kernel modules.

---

### genksyms

genksyms reads (on standard input) the output from gcc -E source.c and generates a file containing version information.

---

### insmod

insmod installs a loadable module in the running kernel.

---

### insmod\_ksymoops\_clean

insmod\_ksymoops\_clean deletes saved ksyms and modules not accessed in 2 days.

---

## **kernelld**

kernelld performs kernel action in user space (such as on-demand loading of modules)

---

## **kernelversion**

kernelversion reports the major version of the running kernel.

---

## **ksyms**

ksyms displays exported kernel symbols.

---

## **lsmod**

lsmod shows information about all loaded modules.

---

## **modinfo**

modinfo examines an object file associated with a kernel module and displays any information that it can glean.

---

## **modprobe**

Modprobe uses a Makefile-like dependency file, created by depmod, to automatically load the relevant module(s) from the set of modules available in predefined directory trees.

---

## **rmmod**

rmmod unloads loadable modules from the running kernel.

---

# Installing Procinfo

## Installation of Procinfo

Edit the `Makefile` file and edit the `CFLAGS` variable if you want to add compiler optimizations to this package.

Install Procinfo by running the following commands:

```
root:procinfo-17# sed "s/-ltermcap/-lncurses/" Makefile
>Makefile2
root:procinfo-17# mv Makefile2 Makefile
root:procinfo-17# make
root:procinfo-17# make install
```

---

## Contents

The Procinfo package contains the `procinfo` program.

---

## Description

`procinfo` gathers some system data from the `/proc` directory and prints it nicely formatted on the standard output device.

---

# Installing Procps

## Installation of Procps

Edit the `Makefile` file and edit the `CFLAGS` variable if you want to add compiler optimizations to this package.

Install Procps by running the following commands:

```
root:procps-2.0.7# sed "s/XConsole/#XConsole/" Makefile
>Makefile2
root:procps-2.0.7# mv Makefile2 Makefile
root:procps-2.0.7# make
root:procps-2.0.7# make install
root:procps-2.0.7# mv /usr/bin/kill /bin
```

---

## Contents

The Procps package contains the `free`, `kill`, `oldps`, `ps`, `skill`, `snice`, `sysctl`, `tload`, `top`, `uptime`, `vmstat`, `w` and `watch` programs.

---

## Description

### **free**

`free` displays the total amount of free and used physical and swap memory in the system, as well as the shared memory and buffers used by the kernel.

---

### **kill**

`kill` sends signals to processes.

---

### **oldps and ps**

`ps` gives a snapshot of the current processes.

---

## **skill**

skill sends signals to process matching a criteria.

---

## **snice**

snice changes the scheduling priority for process matching a criteria.

---

## **sysctl**

sysctl modifies kernel parameters at runtime.

---

## **tload**

tload prints a graph of the current system load average to the specified tty (or the tty of the tload process if none is specified).

---

## **top**

top provides an ongoing look at processor activity in real time.

---

## **uptime**

uptime gives a one line display of the following information: the current time, how long the system has been running, how many users are currently logged on, and the system load averages for the past 1, 5, and 15 minutes.

---

## **vmstat**

vmstat reports information about processes, memory, paging, block IO, traps, and cpu activity.

---

## **w**

w displays information about the users currently on the machine, and their processes.

---

## **watch**

watch runs command repeatedly, displaying its output (the first screenfull).

---

# Installing Psmisc

## Installation of Psmisc

Edit the `Makefile` file and edit the `CFLAGS` variable if you want to add compiler optimizations to this package.

Install Psmisc by running the following commands:

```
root:psmisc# sed "s/-ltermcap/-lncurses/" Makefile >Makefile2
root:psmisc# mv Makefile2 Makefile
root:psmisc# make
root:psmisc# make install
```

---

## Contents

The Psmisc package contains the `fuser`, `killall` and `pstree` programs.

---

## Description

### `fuser`

`fuser` displays the PIDs of processes using the specified files or file systems.

---

### `killall`

`killall` sends a signal to all processes running any of the specified commands.

---

### `pstree`

`pstree` shows running processes as a tree.

---

# Installing Sed

## Installation of Sed

Install Sed by running the following commands:

```
root:sed-3.02# ./configure --prefix=/usr
root:sed-3.02# make
root:sed-3.02# make install
root:sed-3.02# mv /usr/bin/sed /bin
```

---

## Contents

The Sed package contains the sed program.

---

## Description

sed is a stream editor. A stream editor is used to perform basic text transformations on an input stream (a file or input from a pipeline).

---

# Installing Shellutils

## Installation of Shell Utils

Install Shellutils by running the following commands:

```
root:sh-utils-2.0# ./configure --prefix=/usr
root:sh-utils-2.0# make
root:sh-utils-2.0# make install
root:sh-utils-2.0# cd /usr/bin
root:bin# mv date echo false pwd stty /bin
root:bin# mv su true uname hostname /bin
```

---

## Contents

The Shellutils package contains the basename, chroot, date, dirname, echo, env, expr, factor, false, groups, hostid, hostname, id, logname, nice, nohup, pathchk, pinky, printenv, printf, pwd, seq, sleep, stty, su, tee, test, true, tty, uname, uptime, users, who, whoami and yes programs.

---

## Description

### basename

basename strips directory and suffixes from filenames.

---

### chroot

chroot runs a command or interactive shell with special root directory.

---

### date

date displays the current time in a specified format, or sets the system date.

---

### dirname

dirname strips non–directory suffixes from file name.

---

## **echo**

echo displays a line of text.

---

## **env**

env runs a program in a modified environment.

---

## **expr**

expr evaluates expressions.

---

## **factor**

factor prints the prime factors of all specified integer numbers.

---

## **false**

false always exits with a status code indicating failure.

---

## **groups**

groups prints the groups a user is in.

---

## **hostid**

hostid prints the numeric identifier (in hexadecimal) for the current host.

---

## **hostname**

hostname sets or prints the name of the current host system

---

## **id**

id prints the real and effective UIDs and GIDs of a user or the current user.

---

## **logname**

logname prints the current user's login name.

---

## **nice**

nice runs a program with modified scheduling priority.

---

## **nohup**

nohup runs a command immune to hangups, with output to a non-tty

---

## **pathchk**

pathchk checks whether file names are valid or portable.

---

## **pinky**

pinky is a lightweight finger utility which retrieves information about a certain user

---

## **printenv**

printenv prints all or part of the environment.

---

## **printf**

printf formats and print data (the same as the printf C function).

---

## **pwd**

pwd prints the name of the current/working directory

---

## **seq**

seq prints numbers in a certain range with a certain increment.

---

## **sleep**

sleep delays for a specified amount of time.

---

## **stty**

stty changes and prints terminal line settings.

---

## **su**

su runs a shell with substitute user and group IDs

---

## **tee**

tee reads from standard input and write to standard output and files.

---

## **test**

test checks file types and compares values.

---

## **true**

True always exitx with a status code indicating success.

---

## **tty**

tty prints the file name of the terminal connected to standard input.

---

## **uname**

uname prints system information.

---

## **uptime**

uptime tells how long the system has been running.

---

## **users**

users prints the user names of users currently logged in to the current host.

---

## **who**

who shows who is logged on.

---

## **whoami**

whoami prints your effective userid.

---

## **yes**

yes outputs a string repeatedly until killed.

---

# Installing Shadowpwd

## Installation of Shadow Password Suite

Install the Shadow Password Suite by running the following commands:

```
root:shadow-19990827# ./configure --prefix=/usr
root:shadow-19990827# make
root:shadow-19990827# make install
root:shadow-19990827# cd etc
root:etc# cp limits login.access \
> login.defs.linux shells suauth /etc
root:etc# mv /etc/login.defs.linux /etc/login.defs
```

---

## Contents

The Shadow Password Suite contains the chage, chfn, chsh, expiry, faillog, gpasswd, lastlog, login, newgrp, passwd, sg, su, chpasswd, dpasswd, groupadd, groupdel, groupmod, grpck, grpconv, grpunconv, logoutd, mkpasswd, newusers, pwck, pwconv, pwunconv, useradd, userdel, usermod and vipw programs.

---

## Description

### chage

chage changes the number of days between password changes and the date of the last password change.

---

### chfn

chfn changes user fullname, office number, office extension, and home phone number information for a user's account.

---

### chsh

chsh changes the user login shell.

---

## **expiry**

It's currently unknown what this program is for.

---

## **faillog**

faillog formats the contents of the failure log, /var/log/faillog, and maintains failure counts and limits.

---

## **gpasswd**

gpasswd is used to administer the /etc/group file

---

## **lastlog**

lastlog formats and prints the contents of the last login log, /var/log/lastlog. The login-name, port, and last login time will be printed.

---

## **login**

login is used to establish a new session with the system.

---

## **newgrp**

newgrp is used to change the current group ID during a login session.

---

## **passwd**

passwd changes passwords for user and group accounts.

---

## **sg**

sg executes command as a different group ID.

---

## **su**

Change the effective user id and group id to that of a user. This replaces the su programs that's installed from the Shellutils package.

---

## **chpasswd**

chpasswd reads a file of user name and password pairs from standard input and uses this information to update a group of existing users.

---

## **dpasswd**

dpasswd adds, deletes, and updates dialup passwords for user login shells.

---

## **groupadd**

The groupadd command creates a new group account using the values specified on the command line and the default values from the system.

---

## **groupdel**

The groupdel command modifies the system account files, deleting all entries that refer to group.

---

## **groupmod**

The groupmod command modifies the system account files to reflect the changes that are specified on the command line.

---

## **grpck**

grpck verifies the integrity of the system authentication information.

---

## **grpconv**

grpconv converts to shadow group files from normal group files.

---

## **grpunconv**

grpunconv converts from shadow group files to normal group files.

---

## **logoutd**

logoutd enforces the login time and port restrictions specified in /etc/porttime.

---

## **mkpasswd**

mkpasswd reads a file in the format given by the flags and converts it to the corresponding database file format.

---

## **newusers**

newusers reads a file of user name and cleartext password pairs and uses this information to update a group of existing users or to create new users.

---

## **pwck**

pwck verifies the integrity of the system authentication information.

---

## **pwconv**

pwconv converts to shadow passwd files from normal passwd files.

---

## **pwunconv**

pwunconv converts from shadow passwd files to normal files.

---

## **useradd**

useradd creates a new user or update default new user information.

---

## **userdel**

userdel modifies the system account files, deleting all entries that refer to a specified login name.

---

## **usermod**

usermod modifies the system account files to reflect the changes that are specified on the command line.

---

## **vipw and vigr**

vipw and vigr will edit the files `/etc/passwd` and `/etc/group`, respectively. With the `-s` flag, they will edit the shadow versions of those files, `/etc/shadow` and `/etc/gshadow`, respectively.

---

# Installing Sysklogd

## Installation of Sysklogd

Edit the `Makefile` file and edit the `CFLAGS` variable if you want to add compiler optimizations to this package.

Install Sysklogd by running the following commands:

```
root:sysklogd-1.3-31# make  
root:sysklogd-1.3-31# make install
```

---

## Contents

The Sysklogd package contains the `klogd` and `syslogd` programs.

---

## Description

### **klogd**

`klogd` is a system daemon which intercepts and logs Linux kernel messages.

---

### **syslogd**

`Syslogd` provides a kind of logging that many modern programs use. Every logged message contains at least a time and a hostname field, normally a program name field, too, but that depends on how trusty the logging program is.

---

# Installing Sysvinit

## Installation of Sysvinit

Edit the `src/Makefile` file and edit the `CFLAGS` variable if you want to add compiler optimizations to this package.

Install Sysvinit by running the following commands:

```
root:sysvinit-2.78# cd src
root:sysvinit-2.78# make
root:sysvinit-2.78# make install
```

---

## Contents

The Sysvinit package contains the `pidof`, `last`, `lastb`, `mesg`, `utmpdump`, `wall`, `halt`, `init`, `killall5`, `poweroff`, `reboot`, `runlevel`, `shutdown`, `sulogin` and `telinit` programs.

---

## Description

### `pidof`

`Pidof` finds the process id's (pids) of the named programs and prints those id's on standard output.

---

### `last`

`last` searches back through the file `/var/log/wtmp` (or the file designated by the `-f` flag) and displays a list of all users logged in (and out) since that file was created.

---

### `lastb`

`lastb` is the same as `last`, except that by default it shows a log of the file `/var/log/btmp`, which contains all the bad login attempts.

---

### `mesg`

`Mesg` controls the access to your terminal by others. It's typically used to allow or disallow other users to write to your terminal.

## utmpdump

utmpdumps prints the content of a file (usually /var/run/utmp) on standard output in a user friendly format.

---

## wall

Wall sends a message to everybody logged in with their mesg permission set to yes.

---

## halt

Halt notes that the system is being brought down in the file /var/log/wtmp, and then either tells the kernel to halt, reboot or poweroff the system. If halt or reboot is called when the system is not in runlevel 0 or 6, shutdown will be invoked instead (with the flag -h or -r).

---

## init

Init is the parent of all processes. Its primary role is to create processes from a script stored in the file /etc/inittab. This file usually has entries which cause init to spawn gettys on each line that users can log in. It also controls autonomous processes required by any particular system.

---

## killall5

killall5 is the SystemV killall command. It sends a signal to all processes except the processes in its own session, so it won't kill the shell that is running the script it was called from.

---

## poweroff

poweroff is equivalent to shutdown -h -p now. It halts the computer and switches off the computer (when using an APM compliant BIOS and APM is enabled in the kernel).

---

## reboot

reboot is equivalent to shutdown -r now. It reboots the computer.

---

## runlevel

Runlevel reads the system utmp file (typically `/var/run/utmp`) to locate the runlevel record, and then prints the previous and current system runlevel on its standard output, separated by a single space.

---

## shutdown

shutdown brings the system down in a secure way. All logged-in users are notified that the system is going down, and login is blocked.

---

## sulogin

sulogin is invoked by init when the system goes into single user mode (this is done through an entry in `/etc/inittab`). Init also tries to execute sulogin when it is passed the `-b` flag from the bootmonitor (eg, LILO).

---

## telinit

telinit sends appropriate signals to init, telling it which runlevel to change to.

---

# Installing Tar

## Installation of Tar

If you want to apply the Bzip2 tar patch which gives you the `-y` option to tar so you can use bzip2 files with tar, first download the patch from <http://sourceware.cygnum.com/bzip2/> and apply it by running the following command within the src directory under the tar-1.13 directory:

```
root:tar-1.13# cd src
root:src# patch -i ../../gnutarpach.txt
```

Install Tar by running the following commands:

```
root:tar-1.13# ./configure --prefix=/usr
root:tar-1.13# make
root:tar-1.13# make install
root:tar-1.13# mv /usr/bin/tar /bin
```

---

## Contents

The tar package contains the tar and rmt programs.

---

## Description

### tar

tar is an archiving program designed to store and extract files from an archive file known as a tarfile.

---

### rmt

rmt is a program used by the remote dump and restore programs in manipulating a magnetic tape drive through an interprocess communication connection.

---

# Installing Textutils

## Installation of Textutils

Install Textutils by running the following commands:

```
root:textutils-2.0# ./configure --prefix=/usr
root:textutils-2.0# make
root:textutils-2.0# make install
root:textutils-2.0# mv /usr/bin/cat /bin
```

---

## Contents

The Textutils package contains the cat, cksum, comm, split, cut, expand, fmt, fold, head, join, md5sum, nl, od, paste, pr, ptx, sort, split, sum, tac, tail, tr, tsort, unexpand, uniq and wc programs.

---

## Description

### cat

cat concatenates file(s) or standard input to standard output.

---

### cksum

cksum prints CRC checksum and byte counts of each specified file.

---

### comm

comm compares two sorted files line by line.

---

### csplit

csplit outputs pieces of a file separated by (a) pattern(s) to files xx01, xx02, ..., and outputs byte counts of each piece to standard output.

---

## **cut**

cut prints selected parts of lines from specified files to standard output.

---

## **expand**

expand converts tabs in files to spaces, writing to standard output.

---

## **fmt**

fmt reformats each paragraph in the specified file(s), writing to standard output.

---

## **fold**

fold wraps input lines in each specified file (standard input by default), writing to standard output.

---

## **head**

Print first xx (10 by default) lines of each specified file to standard output.

---

## **join**

join joins lines of two files on a common field.

---

## **md5sum**

md5sum prints or checks MD5 checksums.

---

## **nl**

nl writes each specified file to standard output, with line numbers added.

---

## **od**

od writes an unambiguous representation, octal bytes by default, of a specified file to standard output.

---

## **paste**

paste writes lines consisting of the sequentially corresponding lines from each specified file, separated by TABs, to standard output.

---

## **pr**

pr paginates or columnates files for printing.

---

## **ptx**

ptx produces a permuted index of file contents.

---

## **sort**

sort writes sorted concatenation of files to standard output.

---

## **split**

split outputs fixed-size pieces of an input file to PREFIXaa, PREFIXab, ...

---

## **sum**

sum prints checksum and block counts for each specified file.

---

## **tac**

tac writes each specified file to standard output, last line first.

---

## **tail**

tail print the last xx (10 by default) lines of each specified file to standard output.

---

## **tr**

tr translates, squeezes, and/or deletes characters from standard input, writing to standard output.

---

## **tsort**

tsort writes totally ordered lists consistent with the partial ordering in specified files.

---

## **unexpand**

unexpand converts spaces in each file to tabs, writing to standard output.

---

## **uniq**

uniq discards all but one of successive identical lines from files or standard input and writes to files or standard output.

---

## **wc**

wc prints line, word, and byte counts for each specified file, and a total line if more than one file is specified.

---

# Installing Uutilinux

## Installation of Util-Linux

Before we can install the package we have to edit the MCONFIG file, find and modify the following variables as follows:

```
HAVE_SLN=yes
HAVE_TSORT=yes
```

Now find the following lines in the MCONFIG file:

```
ifeq "$(CPU)" "intel"
  OPT=      -pipe -O2 -m486 -fomit-frame-pointer
else
  ifeq "$(CPU)" "arm"
    OPT=      -pipe -O2 -fsigned-char -fomit-frame-pointer
  else
    OPT=      -O2 -fomit-frame-pointer
  endif
endif
```

Modify the proper OPT variable to include the `-mcpu=` and `-march=` options. If you modify the first OPT variable, replace `-m486` with the `-mcpu` variable.

Install Util-Linux by running the following commands:

```
root:util-linux-2.10m# ./configure
root:util-linux-2.10m# make
root:util-linux-2.10m# make install
```

---

## Contents

The Util-linux package contains the arch, dmesg, kill, more, mount, umount, agetty, blockdev, cfdisk, ctrlaltdel, elvtune, fdisk, fsck.minix, hwclock, kbdrate, losetup, mkfs, mkfs.bfs, mkfs.minix, mkswap, sfdisk, swapoff, swapon, cal, chkdupexe, col, colcrt, colrm, column, cytune, ddate, fdformat, getopt, hexdump, ipcrm, ipcs, logger, look, mcookie, namei, rename, renice, rev, script, setfdprm, setuid, setterm, ul, whereis, write, ramsize, rdev, readprofile, rootflags, swapdev, tunelp and vidmode programs.

---

## Description

### arch

arch prints the machine architecture.

---

### dmesg

dmesg is used to examine or control the kernel ring buffer (boot messages from the kernel).

---

### kill

kill sends a specified signal to the specified process.

---

### more

more is a filter for paging through text one screenful at a time.

---

### mount

mount mounts a filesystem from a device to a directory (mount point).

---

### umount

umount unmounts a mounted filesystem.

---

### agetty

agetty opens a tty port, prompts for a login name and invokes the /bin/login command.

---

### blockdev

No description available.

---

## **cfdisk**

cfdisk is an libncurses based disk partition table manipulator.

---

## **ctrlaltdel**

ctrlaltdel sets the function of the CTRL+ALT+DEL key combination (hard or soft reset).

---

## **elvtune**

elvtune allows to tune the I/O elevator per blockdevice queue basis.

---

## **fdisk**

fdisk is a disk partition table manipulator.

---

## **fsck.minix**

fsck.minix performs a consistency check for the Linux MINIX filesystem.

---

## **hwclock**

hwclock queries and sets the hardware clock (Also called the RTC or BIOS clock).

---

## **kbdrate**

kbdrate resets the keyboard repeat rate and delay time.

---

## **losetup**

losetup sets up and controls loop devices.

---

## **mkfs**

mkfs builds a Linux filesystem on a device, usually a harddisk partition.

---

## **mkfs.bfs**

mkfs.bfs creates a SCO bfs file system on a device, usually a harddisk partition.

---

## **mkfs.minix**

mkfs.minix creates a Linux MINIX filesystem on a device, usually a harddisk partition.

---

## **mkswap**

mkswap sets up a Linux swap area on a device or in a file.

---

## **sfdisk**

sfdisk is a disk partition table manipulator.

---

## **swapoff**

swapoff disables devices and files for paging and swapping.

---

## **swapon**

swapon enables devices and files for paging and swapping.

---

## **cal**

cal displays a simple calender.

---

## **chkdupexe**

chkdupexe finds duplicate executables.

---

## **col**

col filters reverse line feeds from input.

---

## **colcrt**

colcrt filters nroff output for CRT previewing.

---

## **colrm**

colrm removes columns from a file.

---

## **column**

column columnates lists.

---

## **cytune**

cytune queries and modifies the interruption threshold for the Cyclades driver.

---

## **ddate**

ddate converts Gregorian dates to Discordian dates.

---

## **fdformat**

fdformat low-level formats a floppy disk.

---

## **getopt**

getops parses command options the same way as the getopt C command.

---

## **hexdump**

hexdump displays specified files, or standard input, in a user specified format (ascii, decimal, hexadecimal, octal).

---

## **ipcrm**

ipcrm removes a specified resource.

---

## **ipcs**

ipcs provides information on ipc facilities.

---

## **logger**

logger makes entries in the system log.

---

## **look**

look displays lines beginning with a given string.

---

## **mcookie**

mcookie generates magic cookies for xauth.

---

## **namei**

namei follows a pathname until a terminal point is found.

---

## **rename**

rename renames files.

---

## **renice**

renice alters priority of running processes.

---

## **rev**

rev reverses lines of a file.

---

## **script**

script makes typescript of terminal session.

---

## **setfdprm**

setfdprm sets user-provides floppy disk parameters.

---

## **setsid**

setsid runs programs in a new session.

---

## **setterm**

setterm sets terminal attributes.

---

## **ul**

ul reads a file and translates occurrences of underscores to the sequence which indicates underlining for the terminal in use.

---

## **whereis**

whereis locates a binary, source and manual page for a command.

---

## **write**

write sends a message to another user.

---

## **ramsize**

ramsize queries and sets RAM disk size.

---

## **rdev**

rdev queries and sets image root device, swap device, RAM disk size, or video mode.

---

## **readprofile**

readprofile reads kernel profiling information.

---

## **rootflags**

rootflags queries and sets extra information used when mounting root.

---

## **swapdev**

swapdev queries and sets swap device.

---

## **tunelp**

tunelp sets various parameters for the lp device.

---

## **vidmode**

vidmode queries and sets the video mode.

---

# Installing Man–pages

## Installation of Man–pages

Install Man–pages by running the following commands:

```
root:man-pages-1.30# yes n|cp -avi man* /usr/share/man
```

---

## Contents

The Man–pages package contains various manual pages that don't come with the packages.

---

## Description

Examples of provided manual pages are the manual pages describing all the C and C++ functions, few important /dev/ files and more.

---

# Removing old NSS library files

If you have copied the NSS Library files from your normal Linux system to the LFS system (because your normal system runs glibc-2.0) it's time to remove them now by running:

```
root:~# rm /lib/libnss*.so.1 /lib/libnss*2.0*
```

---

# Configuring essential software

Now that all software is installed, all that we need to do to get a few programs running properly is to create their configuration files.

---

## Configuring Vim

By default Vim runs in vi compatible mode. Some people might like this, but I have a high preference to run vim in vim mode (else I wouldn't have included Vim in this book but the original Vi). Create the `/root/.vimrc` containing the following:

```
" Begin /root/.vimrc
set nocompatible
set bs=2
" End /root/.vimrc
```

---

## Configuring Glibc

We need to create the `/etc/nsswitch.conf` file. Although glibc should provide defaults when this file is missing or corrupt, it's defaults don't work well with networking which will be dealt with in a later chapter. Also, our timezone needs to be setup.

Create a new file `/etc/nsswitch.conf` containing the following:

```
# Begin /etc/nsswitch.conf
passwd: files
group: files
shadow: files
hosts: files dns
networks: files
protocols: db files
services: db files
ethers: db files
rpc: db files
netgroup: db files
# End /etc/nsswitch.conf
```

Run the `tzselect` script and answer the questions regarding your timezone. When you're done, the script will give you the location of the timezone file you need.

Create the `/etc/localtime` symlink by running:

```

root:~# cd /etc
root:etc# rm localtime
root:etc# ln -s ../usr/share/zoneinfo/<tzselect's output> \
> localtime

```

tzselect's output can be something like *EST5EDT* or *Canada/Eastern*. The symlink you would create with that information would be `ln -s ../usr/share/zoneinfo/EST5EDT localtime` or `ln -s ../usr/share/zoneinfo/Canada/Eastern localtime`

---

## Configuring Dynamic Loader

By default the dynamic loader searches a few default paths for dynamic libraries, so there normally isn't a need for the `/etc/ld.so.conf` file unless you have extra directories in which you want the system to search for paths. The `/usr/local/lib` directory isn't searched through for dynamic libraries by default, so we want to add this path so when you install software you won't be suprised by them not running for some reason.

Create a new file `/etc/ld.so.conf` containing the following:

```

# Begin /etc/ld.so.conf
/lib
/usr/lib
/usr/local/lib
# End /etc/ld.so.conf

```

Although it's not necessary to add the `/lib` and `/usr/lib` directories it doesn't hurt. This way you see right away what's being searched and don't have to remeber the default search paths if you don't want to.

---

## Configuring Lilo

We're not going to create lilo's configuration file from scratch, but we'll use the file from your normal Linux system. This file is different on every machine and thus I can't create it here. Since you would want to have the same options regarding lilo as you have when you're using your normal Linux system you would create the file exactly as it is on the normal system.

Copy the Lilo configuration file and kernel images that Lilo uses by running the following commands from a shell on your normal Linux system. Don't execute these commands from your chroot'ed shell.

```

root:~# cp /etc/lilo.conf $LFS/etc
root:~# cp /boot/<kernel images> $LFS/boot

```

Before you can execute the second command you need to know the names of the kernel images. You can't just copy all files from the `/boot` directory. The `/etc/lilo.conf` file contains the names of the kernel images you're using. Open the file and look for lines like this:

```
image=/boot/vmlinuz
```

Look for all *image* variables and their values represent the name and location of the image files. These files will usually be in `/boot` but they might be in other directories as well, depending on your distribution's conventions.

---

## Configuring Syslogd

Create a new file `/etc/syslog.conf` containing the following:

```
# Begin /etc/syslog.conf
auth,authpriv.* -/var/log/auth.log
*.*;auth,authpriv.none -/var/log/sys.log
daemon.* -/var/log/daemon.log
kern.* -/var/log/kern.log
mail.* -/var/log/mail.log
user.* -/var/log/user.log
*.emerg *
# End /etc/syslog.conf
```

---

## Configuring Shadow Password Suite

This package contains the utilities to modify user's passwords, add new users/groups, delete users/groups and more. I'm not going to explain to you what 'password shadowing' means. You can read all about that in the `doc/HOWTO` file within the unpacked shadow password suite's source tree. There's one thing you should keep in mind, if you decide to use shadow support, that programs that need to verify passwords (examples are `xdm`, `ftp` daemons, `pop3` daemons, etc) need to be 'shadow-compliant', eg. they need to be able to work with shadow'ed passwords.

Shadow'ed passwords are not enabled by default. Simply installing the shadow password suite does not enable shadow'ed passwords.

Now is a very good moment to read chapter 5 of the `doc/HOWTO` file. You can read how you can enable shadow'ed passwords, how to test whether shadowing works and if not, how to disable it again.

---

## Configuring Sysvinit

Create a new file `/etc/inittab` containing the following:

```
# Begin /etc/inittab
id:3:initdefault:
si::sysinit:/etc/init.d/rcS
10:0:wait:/etc/init.d/rc 0
11:S1:wait:/etc/init.d/rc 1
12:2:wait:/etc/init.d/rc 2
13:3:wait:/etc/init.d/rc 3
14:4:wait:/etc/init.d/rc 4
15:5:wait:/etc/init.d/rc 5
16:6:wait:/etc/init.d/rc 6
f1:0:respawn:/sbin/sulogin
f2:6:respawn:/sbin/sulogin
ca:12345:ctrlaltdel:/sbin/shutdown -t1 -a -r now
su:S1:respawn:/sbin/sulogin
1:2345:respawn:/sbin/agetty /dev/tty1 9600
2:2345:respawn:/sbin/agetty /dev/tty2 9600
3:2345:respawn:/sbin/agetty /dev/tty3 9600
4:2345:respawn:/sbin/agetty /dev/tty4 9600
5:2345:respawn:/sbin/agetty /dev/tty5 9600
6:2345:respawn:/sbin/agetty /dev/tty6 9600
# End /etc/inittab
```

---

## Creating the `/var/run/utmp`, `/var/log/wtmp` and `/var/log/btmp` files

Programs like `login`, `shutdown`, `uptime` and others want to read from and write to the `/var/run/utmp`, `/var/log/btmp` and `/var/log/wtmp`. These files contain information about who is currently logged in. It also contains information on when the computer was last booted and shutdown and a record of the bad login attempts.

Create these files with their proper permissions by running the following commands:

```
root:~# touch /var/run/utmp /var/log/wtmp /var/log/btmp
root:~# chmod 644 /var/run/utmp /var/log/wtmp /var/log/btmp
```

---

## Creating root password

Choose a password for user root and create it by running the following command:

```
root:~# passwd root
```

---

# Chapter 7. Creating system boot scripts

# What is being done here

This chapter will create the necessary scripts that are run at boottime. These scripts perform tasks such as remounting the root file system mounted read-only by the kernel into read-write mode, activating the swap partition(s), running a check on the root file system to make sure it's intact and starting the daemons that the system uses.

---

# Creating directories

We need to start by creating a few extra directories that are used by the boot scripts. Create these directories by running:

```
root:~# cd /etc
root:etc# mkdir sysconfig rc0.d rc1.d rc2.d rc3.d
root:etc# mkdir rc4.d rc5.d rc6.d init.d rcS.d
```

---

# Creating the rc script

The first main bootscript is the `/etc/init.d/rc` script. Create a new file `/etc/init.d/rc` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/rc
#
# By Jason Pearce – jason.pearce@linux.org
# Modified by Gerard Beekmans – gerard@linuxfromscratch.org
# print_error_msg based on ideas by Simon Perreault – nomis80@yahoo.com
source /etc/init.d/functions
print_error_msg()
{
    echo
    $FAILURE
    echo -n "You should not read this error message. It means "
    echo "that an unforeseen error "
    echo -n "took place and subscript $i exited with "
    echo "return value "
    echo -n "of $error_value for an unknown reason. If you're able "
    echo "to trace this error down "
    echo -n "to a bug in one of the files provided by this book, "
    echo "please be so kind to "
    echo -n "inform us at lfs-discuss@linuxfromscratch.org"
    $NORMAL
    echo
}
# Un-comment the following for debugging.
# debug=echo
#
# Start script or program.
#
startup() {
case "$1" in
    *.sh)
        $debug sh "$@"
        ;;
    *)
        $debug "$@"
        ;;
esac
}
# Ignore CTRL-C only in this shell, so we can interrupt subprocesses.
trap ":" INT QUIT TSTP
# Set onlcr to avoid staircase effect.
stty onlcr 0>&1
# Now find out what the current and what the previous runlevel are.
runlevel=$RUNLEVEL
# Get first argument. Set new runlevel to this argument.
```

```

[ "$1" != "" ] && runlevel=$1
if [ "$runlevel" = "" ]
then
    echo "Usage: $0 <runlevel>" >&2
    exit 1
fi
previous=$PREVLEVEL
[ "$previous" = "" ] && previous=N
export runlevel previous
# Is there an rc directory for this new runlevel?
if [ -d /etc/rc$runlevel.d ]
then
    # First, run the KILL scripts for this runlevel.
    if [ $previous != N ]
    then
        for i in /etc/rc$runlevel.d/K*
        do
            [ ! -f $i ] && continue
            suffix=${i#/etc/rc$runlevel.d/K[0-9][0-9]}
            previous_start=/etc/rc$previous.d/S[0-9][0-9]$suffix
            sysinit_start=/etc/rcS.d/S[0-9][0-9]$suffix
            # Stop the service if there is a start script
            # in the previous run level.
            [ ! -f $previous_start ] &&
            [ ! -f $sysinit_start ] && continue
            startup $i stop
            error_value=$?
            if [ $error_value != 0 ]
            then
                print_error_msg
            fi
        done
    fi
    # Now run the START scripts for this runlevel.
    for i in /etc/rc$runlevel.d/S*
    do
        [ ! -f $i ] && continue
        if [ $previous != N ]
        then
            # Find start script in previous runlevel and
            # stop script in this runlevel.
            suffix=${i#/etc/rc$runlevel.d/S[0-9][0-9]}
            stop=/etc/rc$runlevel.d/K[0-9][0-9]$suffix
            previous_start=/etc/rc$previous.d/S[0-9][0-9]$suffix
            # If there is a start script in the previous
            # level
            # and _no_ stop script in this level, we don't
            # have to re-start the service.
            [ -f $previous_start ] && [ ! -f $stop ] &&
            continue
        fi
    fi

```

```
case "$runlevel" in
  0|6)
    startup $i stop
    error_value=$?
    if [ $error_value != 0 ]
    then
      print_error_msg
    fi
    ;;
  *)
    startup $i start
    error_value=$?
    if [ $error_value != 0 ]
    then
      print_error_msg
    fi
    ;;
esac
done
fi
# End /etc/init.d/rc
```

---

# Creating the rcS script

The second main bootscript is the rcS script. Create a new file `/etc/init.d/rcS` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/rcS
runlevel=S
prevlevel=N
umask 022
export runlevel prevlevel
trap ":" INT QUIT TSTP
for i in /etc/rcS.d/S??*
do
    [ ! -f "$i" ] && continue;
    $i start
done
# End /etc/init.d/rcS
```

---

# Creating the functions script

Create a new file `/etc/init.d/functions` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/functions
COL=70
SET_COL="echo -en \\033[0;39m"
NORMAL="echo -en \\033[0;39m"
SUCCESS="echo -en \\033[1;32m"
FAILURE="echo -en \\033[1;31m"
evaluate_retval()
{
    if [ $? = 0 ]
    then
        print_status success
    else
        print_status failure
    fi
}
print_status()
{
    if [ $# = 0 ]
    then
        echo "Usage: print_status {success|failure}"
        exit 1
    fi
    case "$1" in
        success)
            $SET_COL
            echo -n "[ "
            $SUCCESS
            echo -n "OK"
            $NORMAL
            echo " ]"
            ;;
        failure)
            $SET_COL
            echo -n "["
            $FAILURE
            echo -n "FAILED"
            $NORMAL
            echo "]"
            ;;
    esac
}
loadproc()
{
    if [ $# = 0 ]
    then
```

```

        echo "Usage: loadproc {program}"
        exit 1
    fi
    base=`basename $1`
    pidlist=`pidof -o $$ -o $PPID -o %PPID -x $base`
    pid=""
    for apid in $pidlist
    do
        if [ -d /proc/$apid ]
        then
            pid="$pid $apid"
        fi
    done
    if [ ! -n "$pid" ]
    then
        $*
        evaluate_retval
    else
        print_status failure
    fi
}
killproc()
{
    if [ $# = 0 ]
    then
        echo "Usage: killproc {program} [signal]"
        exit 1
    fi
    base=`basename $1`
    if [ "$2" != "" ]
    then
        killlevel=$2
    else
        nolevel=1
    fi
    pidlist=`pidof -o $$ -o $PPID -o %PPID -x $base`
    pid=""
    for apid in $pidlist
    do
        if [ -d /proc/$apid ]
        then
            pid="$pid $apid"
        fi
    done
    if [ -n "$pid" ]
    then
        if [ "$nolevel" = 1 ]
        then
            kill -TERM $pid
            if ps h $pid >/dev/null 2>&1
            then

```

```

        kill -KILL $pid
    fi
    ps h $pid >/dev/null 2>&1
    if [ $? = 0 ]
    then
        print_status failure
    else
        rm -f /var/run/$base.pid
        print_status success
    fi
else
    kill $killlevel $pid
    ps h $pid >/dev/null 2>&1
    if [ $? = 0 ]
    then
        print_status failure
    else
        rm -f /var/run/$base.pid
        print_status success
    fi
fi
else
    print_status failure
fi
}
reloadproc()
{
    if [ $# = 0 ]
    then
        echo "Usage: reloadproc {program} [signal]"
        exit 1
    fi
    base=`basename $1`
    if [ -n "$2" ]
    then
        killlevel=$2
    else
        nolevel=1
    fi
    pidlist=`pidof -o $$ -o $PPID -o %PPID -x $base`
    pid=""
    for apid in $pidlist
    do
        if [ -d /proc/$apid ]
        then
            pid="$pid $apid"
        fi
    done
    if [ -n "$pid" ]
    then
        if [ "$nolevel" = 1 ]

```

```

        then
            kill -SIGHUP $pid
            evaluate_retval
        else
            kill $killlevel $pid
            evaluate_retval
        fi
    else
        print_status failure
    fi
}
statusproc()
{
    if [ $# = 0 ]
    then
        echo "Usage: status {program}"
        return 1
    fi
    pid=`pidof -o $$ -o $PPID -o %PPID -x $1`
    if [ -n "$pid" ]
    then
        echo "$1 running with Process ID $pid"
        return 0
    fi
    if [ -f /var/run/$1.pid ]
    then
        pid=`head -1 /var/run/$1.pid`
        if [ -n "$pid" ]
        then
            echo "$1 not running but /var/run/$1.pid exists"
            return 1
        fi
    fi
}
# End /etc/init.d/functions

```

---

# Creating the checkfs script

Create a new file `/etc/init.d/checkfs` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/checkfs
source /etc/init.d/functions
echo -n "Activating swap..."
/sbin/swapon -a
evaluate_retval
if [ -f /fastboot ]
then
    echo "Fast boot, no file system check"
else
    /bin/mount -n -o remount,ro /
    if [ $? = 0 ]
    then
        if [ -f /forcefsck ]
        then
            echo -n "/forcefsck exists, forcing "
            echo "file system check"
            force="-f"
        else
            force=""
        fi
        echo "Checking file systems..."
        /sbin/fsck $force -a -A -C -T
        if [ $? -gt 1 ]
        then
            $FAILURE
            echo
            echo -n "fsck failed. Please repair your file "
            echo "systems manually by running /sbin/fsck"
            echo "without the -a option"
            echo
            echo -n "Please note that the root file system "
            echo "is currently mounted in read-only mode."
            echo
            echo -n "I will start slogin now. When you "
            echo "logout I will reboot your system."
            echo
            $NORMAL
            /sbin/slogin
            /sbin/reboot -f
        else
            print_status success
        fi
    else
        echo -n "Cannot check root file system because it "
        echo "could not be mounted in read-only mode."
```

```
    fi  
fi  
# End /etc/init.d/checkfs
```

---

# Creating the halt script

Create a new file `/etc/init.d/halt` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/halt
/sbin/halt -d -f -i -p
# End /etc/init.d/halt
```

---

# Creating the loadkeys script

You only need to create this script if you don't have a default 101 keys US keyboard layout. Create a new file `/etc/init.d/loadkeys` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/loadkeys
source /etc/init.d/functions
echo -n "Loading keymap..."
/usr/bin/loadkeys -d >/dev/null
evaluate_retval
# End /etc/init.d/loadkeys
```

---

# Creating the mountfs script

Create a new file `/etc/init.d/mountfs` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/mountfs
source /etc/init.d/functions
echo -n "Remounting root file system in read-write mode..."
/bin/mount -n -o remount,rw /
evaluate_retval
echo > /etc/mtab
/bin/mount -f -o remount,rw /
/bin/rm -f /fastboot /forcefsck
echo -n "Mounting other file systems..."
/bin/mount -a
evaluate_retval
# End /etc/init.d/mountfs
```

---

# Creating the reboot script

Create a new file `/etc/init.d/reboot` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/reboot
echo "System reboot in progress..."
/sbin/reboot -d -f -i
# End /etc/init.d/reboot
```

---

# Creating the sendsignals script

Create a new file `/etc/init.d/sendsignals` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/sendsignals
source /etc/init.d/functions
echo -n "Sending all processes the TERM signal..."
/sbin/killall5 -15
evaluate_retval
echo -n "Sending all processes the KILL signal..."
/sbin/killall5 -9
evaluate_retval
# End /etc/init.d/sendsignals
```

---

## Creating the setclock script

The following script is only for real use when your hardware clock (also known as BIOS or CMOS clock) isn't set to GMT time. The recommended setup is setting your hardware clock to GMT and have the time converted to localtime using the `/etc/localtime` symbolic link. But if you run an OS that doesn't understand a clock set to GMT (most notable are Microsoft OS'es) you might want to set your clock to localtime so that the time is properly displayed on those OS'es. This script will reset the kernel time to the hardware clock without converting the time using the `/etc/localtime` symlink.

If you want to use this script on your system even if you have your hardware clock set to GMT, then change the UTC variable below to the value of `1`.

```
#!/bin/sh
# Begin /etc/init.d/setclock
source /etc/init.d/functions
source /etc/sysconfig/clock
CLOCKPARAMS="--hctosys"
case "$UTC" in
    yes|true|1)
        CLOCKPARAMS="$CLOCKPARAMS -u"
        ;;
esac
echo -n "Setting clock..."
/sbin/hwclock $CLOCKPARAMS
evaluate_retval
# End /etc/init.d/setclock
```

---

## Creating the `/etc/sysconfig/clock` file

Create a new file `/etc/sysconfig/clock` containing the following:

```
# Begin /etc/sysconfig/clock
UTC=1
# End /etc/sysconfig/clock
```

If your hardware clock (also known as BIOS or CMOS clock) is not set to GMT time, than set the UTC variable in the `/etc/sysconfig/clock` file to the value `0` (zero).

---

# Creating the syslogd script

Create a new file `/etc/init.d/syslogd` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/syslogd
source /etc/init.d/functions
case "$1" in
    start)
        echo -n "Starting system log daemon..."
        loadproc /usr/sbin/syslogd -m 0
        echo -n "Starting kernel log daemon..."
        loadproc /usr/sbin/klogd
        ;;
    stop)
        echo -n "Stopping kernel log daemon..."
        killproc klogd
        echo -n "Stopping system log daemon..."
        killproc syslogd
        ;;
    reload)
        echo -n "Reloading system log daemon configuration file..."
        reloadproc syslogd -1
        ;;
    restart)
        $0 stop
        sleep 1
        $0 start
        ;;
    status)
        statusproc /usr/sbin/syslogd
        statusproc /usr/sbin/klogd
        ;;
    *)
        echo "Usage: $0 {start|stop|reload|restart|status}"
        exit 1
        ;;
esac
# End /etc/init.d/syslogd
```

---

# Creating the umountfs script

Create a new file `/etc/init.d/umountfs` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/umountfs
source /etc/init.d/functions
echo -n "Deactivating swap..."
/sbin/swapoff -a
evaluate_retval
echo -n "Unmounting file systems..."
/bin/umount -a -r
evaluate_retval
# End /etc/init.d/umountfs
```

---

# Setting up symlinks and permissions

Give these files the proper permissions and create the necessary symlinks by running the following commands:

```
root:~# cd /etc/init.d
root:init.d# chmod 754 rc rcS functions checkfs halt loadkeys
mountfs
root:init.d# chmod 754 reboot sendsignals setclock sysklogd
umountfs
root:init.d# cd ../rc0.d
root:rc0.d# ln -s ../init.d/sysklogd K90sysklogd
root:rc0.d# ln -s ../init.d/sendsignals S80sendsignals
root:rc0.d# ln -s ../init.d/umountfs S90umountfs
root:rc0.d# ln -s ../init.d/halt S99halt
root:rc0.d# cd ../rc6.d
root:rc6.d# ln -s ../init.d/sysklogd K90sysklogd
root:rc6.d# ln -s ../init.d/sendsignals S80sendsignals
root:rc6.d# ln -s ../init.d/umountfs S90umountfs
root:rc6.d# ln -s ../init.d/reboot S99reboot
root:rc6.d# cd ../rcS.d
root:rcS.d# ln -s ../init.d/checkfs S05checkfs
root:rcS.d# ln -s ../init.d/mountfs S10mountfs
root:rcS.d# ln -s ../init.d/setclock S20setclock
root:rcS.d# ln -s ../init.d/loadkeys S30loadkeys
root:rcS.d# cd ../rc1.d
root:rc1.d# ln -s ../init.d/sysklogd K90sysklogd
root:rc1.d# cd ../rc2.d
root:rc2.d# ln -s ../init.d/sysklogd S03sysklogd
root:rc2.d# cd ../rc3.d
root:rc3.d# ln -s ../init.d/sysklogd S03sysklogd
root:rc3.d# cd ../rc4.d
root:rc4.d# ln -s ../init.d/sysklogd S03sysklogd
root:rc4.d# cd ../rc5.d
root:rc5.d# ln -s ../init.d/sysklogd S03sysklogd
```

---

# Creating the /etc/fstab file

In order for certain programs to be able to determine where certain partitions are supposed to be mounted by default, the /etc/fstab file is used. Create a new file /etc/fstab containing the following:

```
# Begin /etc/fstab
/dev/<LFS-partition designation> / ext2 defaults 1 1
/dev/<swap-partition designation> swap swap defaults 0 0
none /proc proc defaults 0 0
# End /etc/fstab
```

Replace <LFS-partition designation> and <swap-partition designation> with the appropriate devices (/dev/hda5 and /dev/hda6 in my case).

---

# Chapter 8. Setting up basic networking

# Introduction

This chapter will setup basic networking. Although you might not be connected to a network, Linux software uses network functions anyway. We'll be installing at least the local loopback device and a network card as well if applicable. Also the proper bootscripts will be created so that networking will be enabled during boot time.

---

# Installing network software

## Installing Netkit-base

Install Netkit-base by running the following commands:

```
root:netkit-base-0.17# ./configure --prefix=/usr
root:netkit-base-0.17# make
root:netkit-base-0.17# make install
root:netkit-base-0.17# cd etc.sample
root:etc.sample# cp services protocols /etc
```

There are other files in the `etc.sample` directory which might be of interest to you.

---

## Installing Net-tools

Edit the `Makefile` file and edit the `CFLAGS` variable if you want to add compiler optimizations.

Install Net-tools by running the following commands:

```
root:net-tools-1.57# make
root:net-tools-1.57# make install
```

You might have noticed that we don't use the compiler optimizations for this package. The reason is that overriding the `CFLAGS` variable causes compilation problems. You would have to edit the `Makefile` file and add the proper values to the `CFLAGS` variable and then compile the package. If you want to do that it's up to you. I don't think it's worth the trouble though. The programs in this package aren't that big that optimization would have any noticeable effect on the performance.

---

# Creating network boot scripts

## Creating the /etc/init.d/localnet bootscrip

Create a new file `/etc/init.d/localnet` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/localnet
source /etc/init.d/functions
source /etc/sysconfig/network
case "$1" in
    start)
        echo -n "Bringing up the loopback interface..."
        /sbin/ifconfig lo 127.0.0.1
        evaluate_retval
        echo -n "Setting up hostname..."
        /bin/hostname $HOSTNAME
        evaluate_retval
        ;;
    stop)
        echo -n "Bringing down the loopback interface..."
        /sbin/ifconfig lo down
        evaluate_retval
        ;;
    *)
        echo "Usage: $0: {start|stop}"
        exit 1
        ;;
esac
# End /etc/init.d/localnet
```

---

## Setting up permissions and symlink

Set the proper file permissions and create the necessary symlink by running the following commands:

```
root:~# cd /etc/init.d
root:init.d# chmod 754 localnet
root:init.d# cd ../rcS.d
root:rcS.d# ln -s ../init.d/localnet S03localnet
```

---

## Creating the `/etc/sysconfig/network` file

Create a new file `/etc/sysconfig/network` and put the hostname in it by running:

```
root:~# echo "HOSTNAME=lhs" > /etc/sysconfig/network
```

Replace "lhs" by the name you wish to call your computer. Please note that you should not enter the FQDN (Fully Qualified Domain Name) here. That information will be put in the `/etc/hosts` file later.

---

## Creating the `/etc/hosts` file

If you want to configure a network card, you have to decide on the IP-address, FQDN and possible aliases for use in the `/etc/hosts` file. An example is:

```
<my-IP> myhost.mydomain.org aliases
```

Make sure the IP-address is in the private network IP-address range. Valid ranges are:

```
Class Networks
A  10.0.0.0
B  172.16.0.0 through 172.31.0.0
C  192.168.0.0 through 192.168.255.0
```

A valid IP address could be 192.168.1.1. A valid FQDN for this IP could be `www.linuxfromscratch.org`

If you're not going to use a network card, you still need to come up with a FQDN. This is necessary for programs like Sendmail to operate correctly (in fact; Sendmail won't run when it can't determine the FQDN).

If you don't configure a network card, create a new file `/etc/hosts` containing:

```
# Begin /etc/hosts (no network card version)
127.0.0.1 www.mydomain.com <value of HOSTNAME> localhost
# End /etc/hosts (no network card version)
```

If you do configure a network card, create a new file `/etc/hosts` containing:

```
# Begin /etc/hosts (network card version)
127.0.0.1 localhost.localdomain localhost
```

```
192.168.1.1 www.mydomain.org <value of HOSTNAME>
# End /etc/hosts (network card version)
```

Of course, change the 192.168.1.1 and www.mydomain.org to your own liking (or requirements if you are assigned an IP-address by a network/system administrator and you plan on connecting this machine to that network).

---

## Creating the `/etc/init.d/ethnet` script

This section only applies if you are going to configure a network card. If you're not, skip this section.

Create a new file `/etc/init.d/ethnet` containing the following:

```
#!/bin/sh
# Begin /etc/init.d/ethnet
source /etc/init.d/functions
source /etc/sysconfig/network
case "$1" in
    start)
        echo -n "Bringing up the eth0 interface..."
        /sbin/ifconfig eth0 $IP broadcast $BROADCAST netmask $NETMASK
        evaluate_retval
        ;;
    stop)
        echo -n "Bringing down the eth0 interface..."
        /sbin/ifconfig eth0 down
        evaluate_retval
        ;;
    *)
        echo "Usage: $0 {start|stop}"
        exit 1
        ;;
esac
# End /etc/init.d/ethnet
```

---

## Editing the `/etc/sysconfig/network` file

Edit the `/etc/sysconfig/network` file and add the following lines to it. Don't remove the `HOSTNAME=` line.

```
IP=192.168.1.1
NETMASK=255.255.255.0
BROADCAST=192.168.1.255
```

Change the IP, NETMASK and BROADCAST values to match your network setup.

---

## Setting up permissions and symlink

Set the proper file permissions and create the necessary symlink by running the following commands:

```
root:~# cd /etc/init.d
root:init.d# chmod 754 ethnet
root:init.d# cd ../rc1.d
root:rc1.d# ln -s ../init.d/ethnet K80ethnet
root:rc1.d# cd ../rc2.d
root:rc2.d# ln -s ../init.d/ethnet K80ethnet
root:rc2.d# cd ../rc3.d
root:rc3.d# ln -s ../init.d/ethnet S10ethnet
root:rc3.d# cd ../rc4.d
root:rc4.d# ln -s ../init.d/ethnet S10ethnet
root:rc4.d# cd ../rc5.d
root:rc5.d# ln -s ../init.d/ethnet S10ethnet
```

---

# Chapter 9. Making the LFS system bootable

# Introduction

This chapter will make LFS bootable. This chapter deals with building a new kernel for our new LFS system and adding the proper entries to LILO so that you can select to boot the LFS system at the LILO: prompt.

---

# Installing a kernel

A kernel is the heart of a Linux system. We could use the kernel image from our normal system, but we might as well compile a new kernel from the most recent kernel sources available.

Building the kernel involves a few steps: configuring it and compiling it. There are a few ways to configure the kernel. If you don't like the way this book does it, read the README file and find out what your other options are. Run the following commands to build the kernel:

```
root:linux# make mrproper
root:linux# make menuconfig
root:linux# make dep
root:linux# make bzImage
root:linux# make modules
root:linux# make modules_install
root:linux# cp arch/i386/boot/bzImage /boot/lfskernel
root:linux# cp System.map /boot
```

---

# Adding an entry to LILO

In order to be able to boot from this partition, we need to update our `/etc/lilo.conf` file. Add the following lines to `lilo.conf`:

```
image=/boot/lfskernel
  label=lfs
  root=<partition>
  read-only
```

`<partition>` must be replaced by your partition's designation (which would be `/dev/hda5` in my case).

Now update the boot loader by running:

```
root:~# lilo
```

---

# Testing the system

Now that all software has been installed, bootscripts have been created and the local network is setup, it's time for you to reboot your computer and test these new scripts to verify that they actually work. You first want to execute them manually from the `/etc/init.d` directory so you can fix the most obvious problems (typos, wrong paths and such). When those scripts seem to work just fine manually they should also work during a system start or shutdown. There's only one way to test that. Shutdown your system with `shutdown -r` now and reboot into LFS. After the reboot you will have a normal login prompt like you have on your normal Linux system (unless you use XDM or some sort of other Display Manger (like KDM – KDE's version of XDM)).

# III. Part III – Appendixes

## *Table of Contents*

A. [Package descriptions](#)

B. [Resources](#)

---

# Appendix A. Package descriptions

# Introduction

This appendix describes the following aspect of each and every package that is installed in this book:

- What every package contains
- What every program from a package does

The packages are listed in the same order as they are installed in chapter 5 (Intel system) or chapter 11 (PPC systems).

Most information about these packages (especially the descriptions of it) come from the man pages from those packages. I'm not going to print the entire man page, just the core elements to make you understand what a program does. If you want to know full details on a program, I suggest you start by reading the complete man page in addition to this appendix.

You will also find that certain packages are documented more in depth than others. The reason is that I just happen to know more about certain packages than I know about others. If you have anything to add on the following descriptions, please don't hesitate to email me. This list is going to contain an in depth description of every package installed, but I can't do this on my own. I have had help from various people but more help is needed.

Please note that currently only what a package does is described and not why you need to install it. That will be added later.

---

# Glibc

## Contents

The Glibc package contains the GNU C Library.

---

## Description

The C Library is a collection of commonly used functions in programs. This way a programmer doesn't need to create his own functions for every single task. The most common things like writing a string to your screen are already present and at the disposal of the programmer.

The C library (actually almost every library) come in two flavours: dynamic ones and static ones. In short when a program uses a static C library, the code from the C library will be copied into the executable file. When a program uses a dynamic library, that executable will not contain the code from the C library, but instead a routine that loads the functions from the library at the time the program is run. This means a significant decrease in the file size of a program. If you don't understand this concept, you better read the documentation that comes with the C Library as it is too complicated to explain here in one or two lines.

---

# Linux kernel

## Contents

The Linux kernel package contains the Linux kernel.

---

## Description

The Linux kernel is at the core of every Linux system. It's what makes Linux tick. When you turn on your computer and boot a Linux system, the very first piece of Linux software that gets loaded is the kernel. The kernel initializes the system's hardware components such as serial ports, parallel ports, sound cards, network cards, IDE controllers, SCSI controllers and a lot more. In a nutshell the kernel makes the hardware available so that the software can run.

---

# Ed

## Contents

The Ed package contains the ed program.

---

## Description

Ed is a line-oriented text editor. It is used to create, display, modify and otherwise manipulate text files.

---

# Patch

## Contents

The Patch package contains the patch program.

---

## Description

The patch program modifies a file according to a patch file. A patch file usually is a list created by the diff program that contains instructions on how an original file needs to be modified. Patch is used a lot for source code patches since it saves time and space. Imagine you have a package that is 1MB in size. The next version of that package only has changes in two files of the first version. You can ship an entirely new package of 1MB or provide a patch file of 1KB which will update the first version to make it identical to the second version. So if you have downloaded the first version already, a patch file can save you a second large download.

---

# **GCC**

## **Contents**

The GCC package contains compilers, preprocessors and the GNU C++ Library.

---

### **Description**

#### **Compiler**

A compiler translates source code in text format to a format that a computer understands. After a source code file is compiled into an object file, a linker will create an executable file from one or more of these compiler generated object files.

---

#### **Pre-processor**

A pre-processor pre-processes a source file, such as including the contents of header files into the source file. You generally don't do this yourself to save yourself a lot of time. You just insert a line like `#include <filename>`. The pre-processor file insert the contents of that file into the source file. That's one of the things a pre-processor does.

---

#### **C++ Library**

The C++ library is used by C++ programs. The C++ library contains functions that are frequently used in C++ programs. This way the programmer doesn't have to write certain functions (such as writing a string of text to the screen) from scratch every time he creates a program.

---

# Bison

## Contents

The Bison package contains the bison program.

---

## Description

Bison is a parser generator, a replacement for YACC. YACC stands for Yet Another Compiler Compiler. What is Bison then? It is a program that generates a program that analyses the structure of a textfile. Instead of writing the actual program you specify how things should be connected and with those rules a program is constructed that analyses the textfile.

There are a lot of examples where structure is needed and one of them is the calculator.

Given the string :

$$1 + 2 * 3$$

You can easily come to the result 7. Why ? Because of the structure. You know how to interpret the string. The computer doesn't know that and Bison is a tool to help it understand by presenting the string in the following way to the compiler:

$$\begin{array}{c} + \\ / \backslash \\ * \ 1 \\ / \backslash \\ 2 \ 3 \end{array}$$

You start at the bottom of a tree and you come across the numbers 2 and 3 which are joined by the multiplication symbol, so the computer multiplies 2 and 3. The result of that multiplication is remembered and the next thing that the computer sees is the result of 2\*3 and the number 1 which are joined by the add symbol. Adding 1 to the previous result makes 7. In calculating the most complex calculations can be broken down in this tree format and the computer just starts at the bottom and works its way up to the top and comes with the correct answer. Of course, Bison isn't only used for calculators alone.

---

# Mawk

## Contents

The Mawk package contains the mawk program.

---

## Description

### gawk

Mawk is an interpreter for the AWK Programming Language. The AWK language is useful for manipulation of data files, text retrieval and processing, and for prototyping and experimenting with algorithms.

---

# Findutils

## Contents

The Findutils package contains the find, locate, updatedb and xargs programs.

---

## Description

### Find

The find program searches for files in a directory hierarchy which match a certain criteria. If no criteria is given, it lists all files in the current directory and its subdirectories.

---

### Locate

Locate scans a database which contain all files and directories on a filesystem. This program lists the files and directories in this database matching a certain criteria. If you're looking for a file this program will scan the database and tell you exactly where the files you requested are located. This only makes sense if your locate database is fairly up-to-date else it will provide you with out-of-date information.

---

### Updatedb

The updatedb program updates the locate database. It scans the entire file system (including other file system that are currently mounted unless you specify it not to) and puts every directory and file it finds into the database that's used by the locate program which retrieves this information. It's a good practice to update this database once a day so that you are ensured of a database that is up-to-date.

---

### Xargs

The xargs command applies a command to a list of files. If you need to perform the same command on multiple files, you can create a file that contains all these files (one per line) and use xargs to perform that command on the list.

---

# Ncurses

## Contents

The Ncurses package contains the ncurses, panel, menu and form libraries. It also contains the tic, infocmp, clear, tput, toe and tset programs.

---

## Description

### The libraries

The libraries that make up the Ncurses library are used to display text (often in a fancy way) on your screen. An example where ncurses is used is in the kernel's "make menuconfig" process. The libraries contain routines to create panels, menu's, form and general text display routines.

---

### Tic

Tic is the terminfo entry–description compiler. The program translates a terminfo file from source format into the binary format for use with the ncurses library routines. Terminfo files contain information about the capabilities of your terminal.

---

### Infocmp

The infocmp program can be used to compare a binary terminfo entry with other terminfo entries, rewrite a terminfo description to take advantage of the use= terminfo field, or print out a terminfo description from the binary file (term) in a variety of formats (the opposite of what tic does).

---

### clear

The clear program clears your screen if this is possible. It looks in the environment for the terminal type and then in the terminfo database to figure out how to clear the screen.

---

### tput

The tput program uses the terminfo database to make the values of terminal–dependent capabilities and information available to the shell, to initialize or reset the terminal, or return the long name of the requested terminal type.

---

## **toe**

The toe program lists all available terminal types by primary name with descriptions.

---

## **tset**

The Tset program initializes terminals so they can be used, but it's not widely used anymore. It's provided for 4.4BSD compatibility.

---

# Less

## Contents

The Less package contains the less program

---

## Description

The less program is a file pager (or text viewer). It displays the contents of a file with the ability to scroll. Less is an improvement on the common pager called "more". Less has the ability to scroll backwards through files as well and it doesn't need to read the entire file when it starts, which makes it faster when you are reading large files.

---

# Groff

## Contents

The Groff packages contains the addftinfo, afmtodit, eqn, grodvi, groff, grog, grohtml, grolj4, grops, grotty, hpftodit, indxbib, lkbib, lookbib, neqn, nroff, pfbtops, pic, psbb, refer, soelim, tbl, tfmtodit and troff programs.

---

## Description

### addftinfo

addftinfo reads a troff font file and adds some additional font–metric information that is used by the groff system.

---

### afmtodit

afmtodit creates a font file for use with groff and grops.

---

### eqn

eqn compiles descriptions of equations embedded within troff input files into commands that are understood by troff.

---

### grodvi

grodvi is a driver for groff that produces TeX dvi format.

---

### groff

groff is a front–end to the groff document formatting system. Normally it runs the troff program and a postprocessor appropriate for the selected device.

---

### grog

grog reads files and guesses which of the groff options `-e`, `-man`, `-me`, `-mm`, `-ms`, `-p`, `-s`, and `-t` are required for printing files, and prints the groff command including those options on the standard output.

---

## **grohtml**

grohtml translates the output of GNU troff to html

---

## **grolj4**

grolj4 is a driver for groff that produces output in PCL5 format suitable for an HP Laserjet 4 printer.

---

## **grops**

grops translates the output of GNU troff to PostScript.

---

## **grotty**

grotty translates the output of GNU troff into a form suitable for typewriter-like devices.

---

## **hpftodit**

hpftodit creates a font file for use with groff -Tlj4 from an HP tagged font metric file.

---

## **indxbib**

indxbib makes an inverted index for the bibliographic databases a specified file for use with refer, lookbib, and lkbib.

---

## **lkbib**

lkbib searches bibliographic databases for references that contain specified keys and prints any references found on the standard output.

---

## **lookbib**

lookbib prints a prompt on the standard error (unless the standard input is not a terminal), reads from the standard input a line containing a set of keywords, searches the bibliographic databases in a specified file for references containing those keywords, prints any references found on the standard output, and repeats this process until the end of input.

---

## neqn

It is currently not known what neqn is and what it does.

---

## nroff

The nroff script emulates the nroff command using groff.

---

## pfbtops

pfbtops translates a PostScript font in .pfb format to ASCII.

---

## pic

pic compiles descriptions of pictures embedded within troff or TeX input files into commands that are understood by TeX or troff.

---

## psbb

psbb reads a file which should be a PostScript document conforming to the Document Structuring conventions and looks for a %%BoundingBox comment.

---

## refer

refer copies the contents of a file to the standard output, except that lines between .[ and .] are interpreted as citations, and lines between .R1 and .R2 are interpreted as commands about how citations are to be processed.

---

## soelim

soelim reads files and replaces lines of the form *.so file* by the contents of *file*.

---

## tbl

tbl compiles descriptions of tables embedded within troff input files into commands that are understood by troff.

---

## **tfmtdit**

tfmtdit creates a font file for use with **groff -Tdvi**

---

## **troff**

troff is highly compatible with Unix troff. Usually it should be invoked using the groff command, which will also run preprocessors and postprocessors in the appropriate order and with the appropriate options.

---

# Man

## Contents

The Man package contains the man, apropos whatis and makewhatis programs.

---

### Description

#### man

man formats and displays the on-line manual pages.

---

#### apropos

apropos searches a set of database files containing short descriptions of system commands for keywords and displays the result on the standard output.

---

#### whatis

whatis searches a set of database files containing short descriptions of system commands for keywords and displays the result on the standard output. Only complete word matches are displayed.

---

#### makewhatis

makewhatis reads all the manual pages contained in given sections of manpath or the preformatted pages contained in the given sections of catpath. For each page, it writes a line in the whatis database; each line consists of the name of the page and a short description, separated by a dash. The description is extracted using the content of the NAME section of the manual page.

---

# Perl

## Contents

The Perl package contains Perl – Practical Extraction and Report Language

---

## Description

Perl combines the features and capabilities of C, awk, sed and sh into one powerful programming language.

---

# M4

## Contents

The M4 package contains the M4 processor

---

## Description

M4 is a macro processor. It copies input to output expanding macros as it goes. Macros are either builtin or user-defined and can take any number of arguments. Besides just doing macro expansion m4 has builtin functions for including named files, running UNIX commands, doing integer arithmetic, manipulating text in various ways, recursion, etc. M4 can be used either as a front-end to a compiler or as a macro processor in its own right.

---

# Texinfo

## Contents

The Texinfo package contains the `info`, `install-info`, `makeinfo`, `texi2dvi` and `texindex` programs

---

### Description

#### `info`

The `info` program reads Info documents, usually contained in your `/usr/doc/info` directory. Info documents are like `man(ual)` pages, but they tend to be more in depth than just explaining the options to a program.

---

#### `install-info`

The `install-info` program updates the info entries. When you run the `info` program a list with available topics (ie: available info documents) will be presented. The `install-info` program is used to maintain this list of available topics. If you decide to remove info files manually, you need to delete the topic in the index file as well. This program is used for that. It also works the other way around when you add info documents.

---

#### `makeinfo`

The `makeinfo` program translates Texinfo source documents into various formats. Available formats are: info files, plain text and HTML.

---

#### `texi2dvi`

The `texi2dvi` program prints Texinfo documents

---

#### `texindex`

The `texindex` program is used to sort Texinfo index files.

---

# Autoconf

## Contents

The Autoconf package contains the autoconf, autoheader, autoreconf, autoscan, autoupdate and ifnames programs

---

## Description

### autoconf

Autoconf is a tool for producing shell scripts that automatically configure software source code packages to adapt to many kinds of UNIX-like systems. The configuration scripts produced by Autoconf are independent of Autoconf when they are run, so their users do not need to have Autoconf.

---

### autoheader

The autoheader program can create a template file of C #define statements for configure to use

---

### autoreconf

If you have a lot of Autoconf-generated configure scripts, the autoreconf program can save you some work. It runs autoconf (and autoheader, where appropriate) repeatedly to remake the Autoconf configure scripts and configuration header templates in the directory tree rooted at the current directory.

---

### autoscan

The autoscan program can help you create a configure.in file for a software package. autoscan examines source files in the directory tree rooted at a directory given as a command line argument, or the current directory if none is given. It searches the source files for common portability problems and creates a file configure.scan which is a preliminary configure.in for that package.

---

### autoupdate

The autoupdate program updates a configure.in file that calls Autoconf macros by their old names to use the current macro names.

---

## **ifnames**

ifnames can help when writing a `configure.in` for a software package. It prints the identifiers that the package already uses in C preprocessor conditionals. If a package has already been set up to have some portability, this program can help you figure out what its `configure` needs to check for. It may help fill in some gaps in a `configure.in` generated by `autoscan`.

---

# Automake

## Contents

The Automake package contains the `aclocal` and `automake` programs

---

### Description

#### `aclocal`

Automake includes a number of Autoconf macros which can be used in your package; some of them are actually required by Automake in certain situations. These macros must be defined in your `aclocal.m4`; otherwise they will not be seen by autoconf.

The `aclocal` program will automatically generate `aclocal.m4` files based on the contents of `configure.in`. This provides a convenient way to get Automake–provided macros, without having to search around. Also, the `aclocal` mechanism is extensible for use by other packages.

---

#### `automake`

To create all the `Makefile.in`'s for a package, run the `automake` program in the top level directory, with no arguments. `automake` will automatically find each appropriate `Makefile.am` (by scanning `configure.in`) and generate the corresponding `Makefile.in`.

---

# Bash

## Contents

The Bash package contains the bash program

---

## Description

Bash is the Bourne–Again SHell, which is a widely used command interpreter on Unix systems. Bash is a program that reads from standard input, the keyboard. You type something and the program will evaluate what you have typed and do something with it, like running a program.

---

# Flex

## Contents

The Flex package contains the flex program

---

## Description

Flex is a tool for generating programs which recognize patterns in text. Pattern recognition is very useful in many applications. You set up rules what to look for and flex will make a program that looks for those patterns. The reason people use flex is that it is much easier to set up rules for what to look for than to write the actual program that finds the text.

---

# Binutils

## Description

The Binutils package contains the ld, as, ar, nm, objcopy, objdump, ranlib, size, strings, strip, c++filt, addr2line and nlmconv programs

---

## Description

### ld

ld combines a number of object and archive files, relocates their data and ties up symbol references. Often the last step in building a new compiled program to run is a call to ld.

---

### as

as is primarily intended to assemble the output of the GNU C compiler gcc for use by the linker ld.

---

### ar

The ar program creates, modifies, and extracts from archives. An archive is a single file holding a collection of other files in a structure that makes it possible to retrieve the original individual files (called members of the archive).

---

### nm

nm lists the symbols from object files.

---

### objcopy

objcopy utility copies the contents of an object file to another. objcopy uses the GNU BFD Library to read and write the object files. It can write the destination object file in a format different from that of the source object file.

---

### objdump

objdump displays information about one or more object files. The options control what particular information to display. This information is mostly useful to programmers who are working on the compilation tools, as opposed to programmers who just want their program to compile and work.

---

## ranlib

ranlib generates an index to the contents of an archive, and stores it in the archive. The index lists each symbol defined by a member of an archive that is a relocatable object file.

---

## size

size lists the section sizes —and the total size— for each of the object files objfile in its argument list. By default, one line of output is generated for each object file or each module in an archive.

---

## strings

For each file given, strings prints the printable character sequences that are at least 4 characters long (or the number specified with an option to the program) and are followed by an unprintable character. By default, it only prints the strings from the initialized and loaded sections of object files; for other types of files, it prints the strings from the whole file.

strings is mainly useful for determining the contents of non-text files.

---

## strip

strip discards all or specific symbols from object files. The list of object files may include archives. At least one object file must be given. strip modifies the files named in its argument, rather than writing modified copies under different names.

---

## c++filt

The C++ language provides function overloading, which means that you can write many functions with the same name (providing each takes parameters of different types). All C++ function names are encoded into a low-level assembly label (this process is known as mangling). The c++filt program does the inverse mapping: it decodes (demangles) low-level names into user-level names so that the linker can keep these overloaded functions from clashing.

---

## addr2line

addr2line translates program addresses into file names and line numbers. Given an address and an executable, it uses the debugging information in the executable to figure out which file name and line number are associated with a given address.

---

## **nlmconv**

nlmconv converts relocatable object files into the NetWare Loadable Module files, optionally reading header files for NLM header information.

---

# Bzip2

## Contents

The Bzip2 packages contains the bzip2, bunzip2, bzip2recover programs.

---

## Description

### Bzip2

bzip2 compresses files using the Burrows–Wheeler block sorting text compression algorithm, and Huffman coding. Compression is generally considerably better than that achieved by more conventional LZ77/LZ78–based compressors, and approaches the performance of the PPM family of statistical compressors.

---

### Bunzip2

Bunzip2 decompresses files that are compressed with bzip2.

---

### bzcat

bzcat (or bzip2 -dc) decompresses all specified files to the standard output.

---

### bzip2recover

bzip2recover recovers data from damaged bzip2 files.

---

# Diffutils

## Contents

The Diffutils package contains the `cmp`, `diff`, `diff3` and `sdiff` programs.

---

### Description

#### `cmp` and `diff`

`cmp` and `diff` both compare two files and report their differences. Both programs have extra options which compare files in different situations.

---

#### `diff3`

The difference between `diff` and `diff3` is that `diff` compares 2 files, `diff3` compares 3 files.

---

#### `sdiff`

`sdiff` merges two two files and interactively outputs the results.

---

# E2fsprogs

## Contents

The e2fsprogs package contains the `chattr`, `lsattr`, `uuidgen`, `badblocks`, `debugfs`, `dumpe2fs`, `e2fsck`, `e2label`, `fsck`, `fsck.ext2`, `mke2fs`, `mkfs.ext2`, `mklost+found` and `tune2fs` programs.

---

## Description

### **chattr**

`chattr` changes the file attributes on a Linux second extended file system.

---

### **lsattr**

`lsattr` lists the file attributes on a second extended file system.

---

### **uuidgen**

The `uuidgen` program creates a new universally unique identifier (UUID) using the `libuuid` library. The new UUID can reasonably be considered unique among all UUIDs created on the local system, and among UUIDs created on other systems in the past and in the future.

---

### **badblocks**

`badblocks` is used to search for bad blocks on a device (usually a disk partition).

---

### **debugfs**

The `debugfs` program is a file system debugger. It can be used to examine and change the state of an ext2 file system.

---

### **dumpe2fs**

`dumpe2fs` prints the super block and blocks group information for the filesystem present on a specified device.

---

## **e2fsck and fsck.ext2**

e2fsck is used to check a Linux second extended file system. fsck.ext2 does the same as e2fsck.

---

## **e2label**

e2label will display or change the filesystem label on the ext2 filesystem located on the specified device.

---

## **fsck**

fsck is used to check and optionally repair a Linux file system.

---

## **mke2fs and mkfs.ext2**

mke2fs is used to create a Linux second extended file system on a device (usually a disk partition). mkfs.ext2 does the same as mke2fs.

---

## **mklost+found**

mklost+found is used to create a lost+found directory in the current working directory on a Linux second extended file system. mklost+found pre-allocates disk blocks to the directory to make it usable by e2fsck.

---

## **tune2fs**

tune2fs adjusts tunable filesystem parameters on a Linux second extended filesystem.

---

# File Contents

The File package contains the file program.

---

## Description

File tests each specified file in an attempt to classify it. There are three sets of tests, performed in this order: filesystem tests, magic number tests, and language tests. The first test that succeeds causes the file type to be printed.

---

# Fileutils

## Contents

The Fileutils package contains the chgrp, chmod, chown, cp, dd, df, dir, dircolors, du, install, ln, ls, mkdir, mkfifo, mknod, mv, rm, rmdir, sync, touch and vdir programs.

---

## Description

### chgrp

chgrp changes the group ownership of each given file to the named group, which can be either a group name or a numeric group ID.

---

### chmod

chmod changes the permissions of each given file according to mode, which can be either a symbolic representation of changes to make, or an octal number representing the bit pattern for the new permissions.

---

### chown

chown changes the user and/or group ownership of each given file.

---

### cp

cp copies files from one place to another.

---

### dd

dd copies a file (from the standard input to the standard output, by default) with a user-selectable blocksize, while optionally performing conversions on it.

---

### df

df displays the amount of disk space available on the filesystem containing each file name argument. If no file name is given, the space available on all currently mounted filesystems is shown.

---

## ls, dir and vdir

dir and vdir are versions of ls with different default output formats. These programs list each given file or directory name. Directory contents are sorted alphabetically. For ls, files are by default listed in columns, sorted vertically, if the standard output is a terminal; otherwise they are listed one per line. For dir, files are by default listed in columns, sorted vertically. For vdir, files are by default listed in long format.

---

## dircolors

dircolors outputs commands to set the LS\_COLOR environment variable. The LS\_COLOR variable is use to change the default color scheme used by ls and related utilities.

---

## du

du displays the amount of disk space used by each argument and for each subdirectory of directory arguments.

---

## install

install copies files and sets their permission modes and, if possible, their owner and group.

---

## ln

ln makes hard or soft (symbolic) links between files.

---

## mkdir

mkdir creates directories with a given name.

---

## mkfifo

mkfifo creates a FIFO with each given name.

---

## mknod

mknod creates a FIFO, character special file, or block special file with the given file name.

---

## **mv**

mv moves files from one directory to another or renames files, depending on the arguments given to mv.

---

## **rm**

rm removes files or directories.

---

## **rmdir**

rmdir removes directories, if they are empty.

---

## **sync**

sync forces changed blocks to disk and updates the super block.

---

## **touch**

touch changes the access and modification times of each given file to the current time. Files that do not exist are created empty.

---

# Gettext

## Contents

The gettext package contains the gettext, gettextize, msgcmp, msgcomm, msgfmt, msgmerge, msgunfmt and xgettext programs.

---

## Description

### gettext

The gettext package is used for internationalization (also known as i18n) and for localization (also known as l10n). Programs can be compiled with Native Language Support (NLS) which enable them to output messages in your native language rather than in the default English language.

---

# Grep

## Contents

The grep package contains the egrep, fgrep and grep programs.

---

## Description

### egrep

egrep prints lines from files matching an extended regular expression pattern.

---

### fgrep

fgrep prints lines from files matching a list of fixed strings, separated by newlines, any of which is to be matched.

---

### grep

grep prints lines from files matching a basic regular expression pattern.

---

# Gzip

## Contents

The Gzip package contains the gunzip, gzexe, gzip, zcat, zcmp, zdiff, zforece, zgrep, zmore and znew programs.

---

## Description

### gunzip

gunzip decompresses files that are compressed with gzip.

---

### gzexe

gzexe allows you to compress executables in place and have them automatically uncompress and execute when you run them (at a penalty in performance).

---

### gzip

gzip reduces the size of the named files using Lempel–Ziv coding (LZ77).

---

### zcat

zcat uncompresses either a list of files on the command line or its standard input and writes the uncompressed data on standard output

---

### zcmp

zcmp invokes the cmp program on compressed files.

---

### zdiff

zdiff invokes the diff program on compressed files.

---

## **zforce**

zforce forces a .gz extension on all gzip files so that gzip will not compress them twice. This can be useful for files with names truncated after a file transfer.

---

## **zgrep**

zgrep invokes the grep program on compressed files.

---

## **zmore**

Zmore is a filter which allows examination of compressed or plain text files one screenful at a time on a soft-copy terminal (similar to the more program).

---

## **znew**

Znew recompresses files from .Z (compress) format to .gz (gzip) format.

---

# Ld.so

## Contents

From the Ld.so package we're using the ldconfig and ldd programs.

---

### Description

#### ldconfig

ldconfig creates the necessary links and cache (for use by the run-time linker, ld.so) to the most recent shared libraries found in the directories specified on the command line, in the file /etc/ld.so.conf, and in the trusted directories (/usr/lib and /lib). ldconfig checks the header and file names of the libraries it encounters when determining which versions should have their links updated.

---

#### ldd

ldd prints the shared libraries required by each program or shared library specified on the command line.

---

# Libtool

## Contents

The Libtool package contains the libtool and libtoolize programs. It also contains the ltdl library.

---

### Description

#### libtool

Libtool provides generalized library–building support services.

---

#### libtoolize

libtoolize provides a standard way to add libtool support to your package.

---

#### ltdl library

Libtool provides a small library, called `libltdl', that aims at hiding the various difficulties of dlopening libraries from programmers.

---

# Bin86

## Contents

The Bin86 contains the as86, as86\_encap, ld86, objdump86, nm86 and size86 programs.

---

### Description

#### as86

as86 is an assembler for the 8086...80386 processors.

---

#### as86\_encap

as86\_encap is a shell script to call as86 and convert the created binary into a C file prog.v to be included in or linked with programs like boot block installers.

---

#### ld86

ld86 understands only the object files produced by the as86 assembler, it can link them into either an impure or a separate I&D executable.

---

#### objdump86

No description available.

---

#### nm86

No description available.

---

#### size86

No description available.

---

# Lilo

## Contents

The Lilo package contains the lilo program.

---

## Description

lilo installs the Linux boot loader which is used to start a Linux system.

---

# Make

## Contents

The Make package contains the make program.

---

## Description

make determine automatically which pieces of a large program need to be recompiled, and issue the commands to recompile them.

---

# Shellutils

## Contents

The Shellutils package contains the `basename`, `chroot`, `date`, `dirname`, `echo`, `env`, `expr`, `factor`, `false`, `groups`, `hostid`, `hostname`, `id`, `logname`, `nice`, `nohup`, `pathchk`, `pinky`, `printenv`, `printf`, `pwd`, `seq`, `sleep`, `stty`, `su`, `tee`, `test`, `true`, `tty`, `uname`, `uptime`, `users`, `who`, `whoami` and `yes` programs.

---

## Description

### **basename**

`basename` strips directory and suffixes from filenames.

---

### **chroot**

`chroot` runs a command or interactive shell with special root directory.

---

### **date**

`date` displays the current time in a specified format, or sets the system date.

---

### **dirname**

`dirname` strips non–directory suffixes from file name.

---

### **echo**

`echo` displays a line of text.

---

### **env**

`env` runs a program in a modified environment.

---

### **expr**

`expr` evaluates expressions.

---

## **factor**

factor prints the prime factors of all specified integer numbers.

---

## **false**

false always exits with a status code indicating failure.

---

## **groups**

groups prints the groups a user is in.

---

## **hostid**

hostid prints the numeric identifier (in hexadecimal) for the current host.

---

## **hostname**

hostname sets or prints the name of the current host system

---

## **id**

id prints the real and effective UIDs and GIDs of a user or the current user.

---

## **logname**

logname prints the current user's login name.

---

## **nice**

nice runs a program with modified scheduling priority.

---

## **nohup**

nohup runs a command immune to hangups, with output to a non-tty

---

## **pathchk**

pathchk checks whether file names are valid or portable.

---

## **pinky**

pinky is a lightweight finger utility which retrieves information about a certain user

---

## **printenv**

printenv prints all or part of the environment.

---

## **printf**

printf formats and print data (the same as the printf C function).

---

## **pwd**

pwd prints the name of the current/working directory

---

## **seq**

seq prints numbers in a certain range with a certain increment.

---

## **sleep**

sleep delays for a specified amount of time.

---

## **stty**

stty changes and prints terminal line settings.

---

## **su**

su runs a shell with substitute user and group IDs

---

## **tee**

tee reads from standard input and write to standard output and files.

---

## **test**

test checks file types and compares values.

---

## **true**

True always exitx with a status code indicating success.

---

## **tty**

tty prints the file name of the terminal connected to standard input.

---

## **uname**

uname prints system information.

---

## **uptime**

uptime tells how long the system has been running.

---

## **users**

users prints the user names of users currently logged in to the current host.

---

## **who**

who shows who is logged on.

---

## **whoami**

whoami prints your effective userid.

---

## **yes**

yes outputs a string repeatedly until killed.

---

# Shadow Password Suite

## Contents

The Shadow Password Suite contains the chage, chfn, chsh, expiry, faillog, gpasswd, lastlog, login, newgrp, passwd, sg, su, chpasswd, dpasswd, groupadd, groupdel, groupmod, grpck, grpconv, grpunconv, logoutd, mkpasswd, newusers, pwck, pwconv, pwunconv, useradd, userdel, usermod and vipw programs.

---

## Description

### chage

chage changes the number of days between password changes and the date of the last password change.

---

### chfn

chfn changes user fullname, office number, office extension, and home phone number information for a user's account.

---

### chsh

chsh changes the user login shell.

---

### expiry

It's currently unknown what this program is for.

---

### faillog

faillog formats the contents of the failure log, /var/log/faillog, and maintains failure counts and limits.

---

### gpasswd

gpasswd is used to administer the /etc/group file

---

## **lastlog**

lastlog formats and prints the contents of the last login log, /var/log/lastlog. The login-name, port, and last login time will be printed.

---

## **login**

login is used to establish a new session with the system.

---

## **newgrp**

newgrp is used to change the current group ID during a login session.

---

## **passwd**

passwd changes passwords for user and group accounts.

---

## **sg**

sg executes command as a different group ID.

---

## **su**

Change the effective user id and group id to that of a user. This replaces the su programs that's installed from the Shellutils package.

---

## **chpasswd**

chpasswd reads a file of user name and password pairs from standard input and uses this information to update a group of existing users.

---

## **dpasswd**

dpasswd adds, deletes, and updates dialup passwords for user login shells.

---

## **groupadd**

The groupadd command creates a new group account using the values specified on the command line and the default values from the system.

---

## **groupdel**

The groupdel command modifies the system account files, deleting all entries that refer to group.

---

## **groupmod**

The groupmod command modifies the system account files to reflect the changes that are specified on the command line.

---

## **grpck**

grpck verifies the integrity of the system authentication information.

---

## **grpconv**

grpconv converts to shadow group files from normal group files.

---

## **grpunconv**

grpunconv converts from shadow group files to normal group files.

---

## **logoutd**

logoutd enforces the login time and port restrictions specified in /etc/porttime.

---

## **mkpasswd**

mkpasswd reads a file in the format given by the flags and converts it to the corresponding database file format.

---

## **newusers**

newusers reads a file of user name and cleartext password pairs and uses this information to update a group of existing users or to create new users.

---

## **pwck**

pwck verifies the integrity of the system authentication information.

---

## **pwconv**

pwconv converts to shadow passwd files from normal passwd files.

---

## **pwunconv**

pwunconv converts from shadow passwd files to normal files.

---

## **useradd**

useradd creates a new user or update default new user information.

---

## **userdel**

userdel modifies the system account files, deleting all entries that refer to a specified login name.

---

## **usermod**

usermod modifies the system account files to reflect the changes that are specified on the command line.

---

## **vipw and vigr**

vipw and vigr will edit the files `/etc/passwd` and `/etc/group`, respectively. With the `-s` flag, they will edit the shadow versions of those files, `/etc/shadow` and `/etc/gshadow`, respectively.

---

# Modutils

## Contents

The Modutils package contains the depmod, genksyms, insmod, insmod\_ksymoops\_clean, kerneld, kernelversion, ksyms, lsmod, modinfo, modprobe and rmmod programs.

---

## Description

### depmod

depmod handles dependency descriptions for loadable kernel modules.

---

### genksyms

genksyms reads (on standard input) the output from gcc -E source.c and generates a file containing version information.

---

### insmod

insmod installs a loadable module in the running kernel.

---

### insmod\_ksymoops\_clean

insmod\_ksymoops\_clean deletes saved ksyms and modules not accessed in 2 days.

---

### kerneld

kerneld performs kernel action in user space (such as on-demand loading of modules)

---

### kernelversion

kernelversion reports the major version of the running kernel.

---

### ksyms

ksyms displays exported kernel symbols.

---

## **lsmod**

lsmod shows information about all loaded modules.

---

## **modinfo**

modinfo examines an object file associated with a kernel module and displays any information that it can glean.

---

## **modprobe**

Modprobe uses a Makefile–like dependency file, created by depmod, to automatically load the relevant module(s) from the set of modules available in predefined directory trees.

---

## **rmmod**

rmmod unloads loadable modules from the running kernel.

---

# Procinfo

## Contents

The Procinfo package contains the procinfo program.

---

## Description

procinfo gathers some system data from the /proc directory and prints it nicely formatted on the standard output device.

---

# Procps

## Contents

The Procps package contains the free, kill, oldps, ps, skill, snice, sysctl, tload, top, uptime, vmstat, w and watch programs.

---

### Description

#### free

free displays the total amount of free and used physical and swap memory in the system, as well as the shared memory and buffers used by the kernel.

---

#### kill

kill sends signals to processes.

---

#### oldps and ps

ps gives a snapshot of the current processes.

---

#### skill

skill sends signals to process matching a criteria.

---

#### snice

snice changes the scheduling priority for process matching a criteria.

---

#### sysctl

sysctl modifies kernel parameters at runtime.

---

#### tload

tload prints a graph of the current system load average to the specified tty (or the tty of the tload process if none is specified).

## **top**

top provides an ongoing look at processor activity in real time.

---

## **uptime**

uptime gives a one line display of the following information: the current time, how long the system has been running, how many users are currently logged on, and the system load averages for the past 1, 5, and 15 minutes.

---

## **vmstat**

vmstat reports information about processes, memory, paging, block IO, traps, and cpu activity.

---

## **w**

w displays information about the users currently on the machine, and their processes.

---

## **watch**

watch runs command repeatedly, displaying its output (the first screenfull).

---

# Vim

## Contents

The Vim package contains the ctags, etags, ex, gview, gvim, rgview, rgvim, rview, rvim, view, vim, vintutor and xxd programs.

---

## Description

### ctags

ctags generate tag files for source code.

---

### etags

etags does the same as ctags but it can generate cross reference files which list information about the various source objects found in a set of lanugage files.

---

### ex

ex starts vim in Ex mode.

---

### gview

gview is the GUI version of view.

---

### gvim

gvim is the GUI version of vim.

---

### rgview

rgview is teh GUI version of rview.

---

### rgvim

rgvim is the GUI version of rvim.

---

## **rview**

rview is a restricted version of view. No shell commands can be started and Vim can't be suspended.

---

## **rvim**

rvim is the restricted version of vim. No shell commands can be started and Vim can't be suspended.

---

## **view**

view starts vim in read-only mode.

---

## **vim**

vim starts vim in the normal, default way.

---

## **vimtutor**

vimtutor starts the Vim tutor.

---

## **xxd**

xxd makes a hexdump or does the reverse.

---

# Psmisc

## Contents

The Psmisc package contains the fuser, killall and pstree programs.

---

### Description

#### **fuser**

fuser displays the PIDs of processes using the specified files or file systems.

---

#### **killall**

killall sends a signal to all processes running any of the specified commands.

---

#### **pstree**

pstree shows running processes as a tree.

---

# Sed

## Contents

The Sed package contains the sed program.

---

## Description

sed is a stream editor. A stream editor is used to perform basic text transformations on an input stream (a file or input from a pipeline).

---

# Sysklogd

## Contents

The Sysklogd package contains the klogd and syslogd programs.

---

## Description

### klogd

klogd is a system daemon which intercepts and logs Linux kernel messages.

---

### syslogd

Syslogd provides a kind of logging that many modern programs use. Every logged message contains at least a time and a hostname field, normally a program name field, too, but that depends on how trusty the logging program is.

---

# Sysvinit

## Contents

The Sysvinit package contains the pidof, last, lastb, mesg, utmpdump, wall, halt, init, killall5, poweroff, reboot, runlevel, shutdown, sulogin and telinit programs.

---

## Description

### pidof

Pidof finds the process id's (pids) of the named programs and prints those id's on standard output.

---

### last

last searches back through the file `/var/log/wtmp` (or the file designated by the `-f` flag) and displays a list of all users logged in (and out) since that file was created.

---

### lastb

lastb is the same as last, except that by default it shows a log of the file `/var/log/btmp`, which contains all the bad login attempts.

---

### mesg

Mesg controls the access to your terminal by others. It's typically used to allow or disallow other users to write to your terminal.

---

### utmpdump

utmpdumps prints the content of a file (usually `/var/run/utmp`) on standard output in a user friendly format.

---

### wall

Wall sends a message to everybody logged in with their mesg permission set to yes.

---

## halt

Halt notes that the system is being brought down in the file `/var/log/wtmp`, and then either tells the kernel to halt, reboot or poweroff the system. If halt or reboot is called when the system is not in runlevel 0 or 6, shutdown will be invoked instead (with the flag `-h` or `-r`).

---

## init

Init is the parent of all processes. Its primary role is to create processes from a script stored in the file `/etc/inittab`. This file usually has entries which cause init to spawn gettys on each line that users can log in. It also controls autonomous processes required by any particular system.

---

## killall5

killall5 is the SystemV killall command. It sends a signal to all processes except the processes in its own session, so it won't kill the shell that is running the script it was called from.

---

## poweroff

poweroff is equivalent to `shutdown -h -p now`. It halts the computer and switches off the computer (when using an APM compliant BIOS and APM is enabled in the kernel).

---

## reboot

reboot is equivalent to `shutdown -r now`. It reboots the computer.

---

## runlevel

Runlevel reads the system utmp file (typically `/var/run/utmp`) to locate the runlevel record, and then prints the previous and current system runlevel on its standard output, separated by a single space.

---

## shutdown

shutdown brings the system down in a secure way. All logged-in users are notified that the system is going down, and login is blocked.

---

## **sulogin**

sulogin is invoked by init when the system goes into single user mode (this is done through an entry in `/etc/inittab`). Init also tries to execute sulogin when it is passed the `-b` flag from the bootmonitor (eg, LILO).

---

## **telinit**

telinit sends appropriate signals to init, telling it which runlevel to change to.

---

# Tar

## Contents

The tar package contains the tar and rmt programs.

---

## Description

### tar

tar is an archiving program designed to store and extract files from an archive file known as a tarfile.

---

### rmt

rmt is a program used by the remote dump and restore programs in manipulating a magnetic tape drive through an interprocess communication connection.

---

# Textutils

## Contents

The Textutils package contains the cat, cksum, comm, split, cut, expand, fmt, fold, head, join, md5sum, nl, od, paste, pr, ptx, sort, split, sum, tac, tail, tr, tsort, unexpand, uniq and wc programs.

---

## Description

### cat

cat concatenates file(s) or standard input to standard output.

---

### cksum

cksum prints CRC checksum and byte counts of each specified file.

---

### comm

comm compares two sorted files line by line.

---

### csplit

csplit outputs pieces of a file separated by (a) pattern(s) to files xx01, xx02, ..., and outputs byte counts of each piece to standard output.

---

### cut

cut prints selected parts of lines from specified files to standard output.

---

### expand

expand converts tabs in files to spaces, writing to standard output.

---

### fmt

fmt reformats each paragraph in the specified file(s), writing to standard output.

---

## **fold**

fold wraps input lines in each specified file (standard input by default), writing to standard output.

---

## **head**

Print first xx (10 by default) lines of each specified file to standard output.

---

## **join**

join joins lines of two files on a common field.

---

## **md5sum**

md5sum prints or checks MD5 checksums.

---

## **nl**

nl writes each specified file to standard output, with line numbers added.

---

## **od**

od writes an unambiguous representation, octal bytes by default, of a specified file to standard output.

---

## **paste**

paste writes lines consisting of the sequentially corresponding lines from each specified file, separated by TABs, to standard output.

---

## **pr**

pr paginates or columnates files for printing.

---

## **ptx**

ptx produces a permuted index of file contents.

---

## **sort**

sort writes sorted concatenation of files to standard output.

---

## **split**

split outputs fixed-size pieces of an input file to PREFIXaa, PREFIXab, ...

---

## **sum**

sum prints checksum and block counts for each specified file.

---

## **tac**

tac writes each specified file to standard output, last line first.

---

## **tail**

tail print the last xx (10 by default) lines of each specified file to standard output.

---

## **tr**

tr translates, squeezes, and/or deletes characters from standard input, writing to standard output.

---

## **tsort**

tsort writes totally ordered lists consistent with the partial ordering in specified files.

---

## **unexpand**

unexpand converts spaces in each file to tabs, writing to standard output.

---

## **uniq**

uniq discards all but one of successive identical lines from files or standard input and writes to files or standard output.

---

## **wc**

wc prints line, word, and byte counts for each specified file, and a total line if more than one file is specified.

---

# Util Linux

## Contents

The Util-linux package contains the arch, dmesg, kill, more, mount, umount, agetty, blockdev, cfdisk, ctrlaltdel, elvtune, fdisk, fsck.minix, hwclock, kbdrate, losetup, mkfs, mkfs.bfs, mkfs.minix, mkswap, sfdisk, swapoff, swapon, cal, chkdupexe, col, colcrt, colrm, column, cytune, ddate, fdformat, getopt, hexdump, ipcrm, ipcs, logger, look, mcookie, namei, rename, renice, rev, script, setfdprm, setuid, setterm, ul, whereis, write, ramsize, rdev, readprofile, rootflags, swapdev, tunelp and vidmode programs.

---

## Description

### arch

arch prints the machine architecture.

---

### dmesg

dmesg is used to examine or control the kernel ring buffer (boot messages from the kernel).

---

### kill

kill sends a specified signal to the specified process.

---

### more

more is a filter for paging through text one screenful at a time.

---

### mount

mount mounts a filesystem from a device to a directory (mount point).

---

### umount

umount unmounts a mounted filesystem.

---

## **agetty**

agetty opens a tty port, prompts for a login name and invokes the /bin/login command.

---

## **blockdev**

No description available.

---

## **fdisk**

fdisk is an libncurses based disk partition table manipulator.

---

## **ctrlaltdel**

ctrlaltdel sets the function of the CTRL+ALT+DEL key combination (hard or soft reset).

---

## **elvtune**

elvtune allows to tune the I/O elevator per blockdevice queue basis.

---

## **fdisk**

fdisk is a disk partition table manipulator.

---

## **fsck.minix**

fsck.minix performs a consistency check for the Linux MINIX filesystem.

---

## **hwclock**

hwclock queries and sets the hardware clock (Also called the RTC or BIOS clock).

---

## **kbdrate**

kbdrate resets the keyboard repeat rate and delay time.

---

## **losetup**

losetup sets up and controls loop devices.

---

## **mkfs**

mkfs builds a Linux filesystem on a device, usually a harddisk partition.

---

## **mkfs.bfs**

mkfs.bfs creates a SCO bfs file system on a device, usually a harddisk partition.

---

## **mkfs.minix**

mkfs.minix creates a Linux MINIX filesystem on a device, usually a harddisk partition.

---

## **mkswap**

mkswap sets up a Linux swap area on a device or in a file.

---

## **sfdisk**

sfdisk is a disk partition table manipulator.

---

## **swapoff**

swapoff disables devices and files for paging and swapping.

---

## **swapon**

swapon enables devices and files for paging and swapping.

---

## **cal**

cal displays a simple calender.

---

## **chkdupexe**

chkdupexe finds duplicate executables.

---

## **col**

col filters reverse line feeds from input.

---

## **colcrt**

colcrt filters nroff output for CRT previewing.

---

## **colrm**

colrm removes columns from a file.

---

## **column**

column columnates lists.

---

## **cytune**

cytune queries and modifies the interruption threshold for the Cyclades driver.

---

## **ddate**

ddate converts Gregorian dates to Discordian dates.

---

## **fdformat**

fdformat low-level formats a floppy disk.

---

## **getopt**

getops parses command options the same way as the getopt C command.

---

## **hexdump**

hexdump displays specified files, or standard input, in a user specified format (ascii, decimal, hexadecimal, octal).

---

## **ipcrm**

ipcrm removes a specified resource.

---

## **ipcs**

ipcs provides information on ipc facilities.

---

## **logger**

logger makes entries in the system log.

---

## **look**

look displays lines beginning with a given string.

---

## **mcookie**

mcookie generates magic cookies for xauth.

---

## **namei**

namei follows a pathname until a terminal point is found.

---

## **rename**

rename renames files.

---

## **renice**

renice alters priority of running processes.

---

## **rev**

rev reverses lines of a file.

---

## **script**

script makes typescript of terminal session.

---

## **setfdprm**

setfdprm sets user—provides floppy disk parameters.

---

## **setsid**

setsid runs programs in a new session.

---

## **setterm**

setterm sets terminal attributes.

---

## **ul**

ul reads a file and translates occurrences of underscores to the sequence which indicates underlining for the terminal in use.

---

## **whereis**

whereis locates a binary, source and manual page for a command.

---

## **write**

write sends a message to another user.

---

## **ramsize**

ramsize queries and sets RAM disk size.

---

## **rdev**

rdev queries and sets image root device, swap device, RAM disk size, or video mode.

---

## **readprofile**

readprofile reads kernel profiling information.

---

## **rootflags**

rootflags queries and sets extra information used when mounting root.

---

## **swapdev**

swapdev queries and sets swap device.

---

## **tunelp**

tunelp sets various parameters for the lp device.

---

## **vidmode**

vidmode queries and sets the video mode.

---

# Console-tools

## Contents

The Console-tools package contains the charset, chvt, consolechars, deallocvt, dumpkeys, fgconsole, fix\_bs\_and\_del, font2psf, getkeycodes, kbd\_mode, loadkeys, loadunimap, mapscrn, mk\_modmap, openvt, psfaddtable, psfgettable, psfstriptime, resizecons, saveunimap, screendump, setfont, setkeycodes, setleds, setmetamode, setvesablank, showcfont, showkey, splitfont, unicode\_start, unicode\_stop, vcstime, vt-is-URF8, writetv

---

## Description

### charset

charset sets an ACM for use in one of the G0/G1 charsets slots.

---

### chvt

chvt changes foreground virtual terminal.

---

### codepage

No description available.

---

### consolechars

consolechars loads EGA/VGA console screen fonts, screen font maps and/or application-charset maps.

---

### deallocvt

deallocvt deallocates unused virtual terminals.

---

### dumpkeys

dumpkeys dumps keyboard translation tables.

---

## **fgconsole**

fgconsole prints the number of the active virtual terminal.

---

## **fix\_bs\_and\_del**

No description available.

---

## **font2psf**

No description available.

---

## **getkeycodes**

getkeycodes prints the kernel scancode-to-keycode mapping table.

---

## **kbd\_mode**

kbd\_mode reports or sets the keyboard mode.

---

## **loadkeys**

loadkeys loads keyboard translation tables.

---

## **loadunimap**

No description available.

---

## **mapscrn**

No description available.

---

## **mk\_modmap**

No description available.

---

## **openvt**

openvt starts a program on a new virtual terminal.

---

## **psfaddtable**

psfaddtable adds a Unicode character table to a console font.

---

## **psfgettable**

psfgettable extracts the embedded Unicode character table from a console font.

---

## **psfstriptable**

psfstriptable removes the embedded Unicode character table from a console font.

---

## **resizecons**

resizecons changes the kernel idea of the console size.

---

## **saveunimap**

No description available.

---

## **screendump**

No description available.

---

## **setfont**

No description available.

---

## **setkeycodes**

setkeycodes loads kernel scancode-to-keycode mapping table entries.

---

## **setleds**

setleds sets the keyboard leds.

---

## **setmetamode**

setmetamode defines the keyboard meta key handling.

---

## **setvesablank**

No description available.

---

## **showcfont**

showcfont displays all character in the current screenfont.

---

## **showkey**

showkey examines the scancodes and keycodes sent by the keyboard.

---

## **splitfont**

No description available.

---

## **unicode\_start**

unicode\_start puts the console in Unicode mode.

---

## **unicode\_stop**

No description available.

---

## **vcstime**

No description available.

---

## **vt-is-UTF8**

vt-is-UTF8 checks whether the current virtual terminal is in UTF8- or byte-mode.

---

## **writetv**

No description available.

---

# Console–data

## Contents

The console–data package contains the data files that are used and needed by the console–tools package.

---

# Man–pages

## Contents

The Man–pages package contains various manual pages that don't come with the packages.

---

## Description

Examples of provided manual pages are the manual pages describing all the C and C++ functions, few important /dev/ files and more.

---

# Appendix B. Resources

# Introduction

A list of books, HOWTOs and other documents you might find useful to download or buy follows. This list is just a small list to start with. We hope to be able to expand this list in time as we come across more useful documents or books.

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# Books

- Linux Network Administrator's Guide published by O'Reilly. ISBN: 1-56502-087-2
  - Running Linux published by O'Reilly. ISBN: 1-56592-151-8
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# HOWTOs and Guides

All of the following HOWTOs can be downloaded from the Linux Documentation Project site at <http://www.linuxdoc.org>

- Linux Network Administrator's Guide
  - Powerup2Bash-HOWTO
-

# Other

- The various man and info pages that come with the packages