

# Installing Debian GNU/Linux on a Dell Latitude C840

---

Version 1.15  
2003-08-20 23:11:00

**François TOURDE**

---

Copyright © 2003 **François TOURDE**.

Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the license is included in the section entitled "GNU Free Documentation License".

All copies must keep this notice.

# Table of Contents

<b>1</b>	<b>Introduction .....</b>	<b>1</b>
<b>2</b>	<b>Updates .....</b>	<b>2</b>
<b>3</b>	<b>Hardware configuration .....</b>	<b>3</b>
<b>4</b>	<b>Procedure .....</b>	<b>6</b>
	4.1 Partitionning.....	6
	4.2 Modules.....	6
	4.3 Installing the packages.....	6
	4.4 First customisations.....	6
	4.5 Compiling the kernel.....	7
<b>5</b>	<b>Specific Hardware Support.....</b>	<b>9</b>
	5.1 Closing the screen.....	9
	5.2 Fans and function keys.....	9
	5.3 Burner.....	10
	5.4 Modem.....	10
	5.5 IrDA.....	10
<b>6</b>	<b>Outstanding issues .....</b>	<b>12</b>
	<b>Appendix A GNU Free Documentation License.....</b>	<b>13</b>
	A.0.1 ADDENDUM: How to use this License for your documents.....	19

# 1 Introduction

This document only describes how I installed Debian GNU/Linux on my laptop. It is not a reference document. It is up to **you** to make the choices for your laptop.

**Remarks** and contributions to this document are welcome.

Thanks to Klaas GADEYNE for his **document**, which greatly inspired this one.

Thanks to **Yves RÜTSCHLÉ** for the english translation, as fast as accurate.

Thanks to everyone else who writes in **linux-laptop.net**, **TuxMobil.org**, or in the Debian mailing lists dedicated to these topics ( **debian-laptop@lists.debian.org**, **debian-user-french@lists.debian.org**, etc.)

Thanks, finally, to **Loic** and **Rodolphe** who insisted enough to convince me to release this document, whatever its state was.

One can sort out in too much information, but nothing can be done without information.

This document is to be taken "as is," with no warranties.

## 2 Updates

26 October 2003

Overdue proofreading and editing. This is a Halloween revision, started while preparing pumpkin pie, and finished while eating it.

20 August 2003

Translation of the document in English.

21st June, 2003

The geek in me prevents me to realise it's saturday, and that the music festival is tonight, yet I am working on the document. Infra-red now works correctly for me to synchronise my Palm, and to establish a PPP link through my phone.

28 April 2003

**Jej** pointed out that I forgot a `#if 0` in `'nv.c'`. Aren't I distracted!

31st March 2003

Keyboard speed problem fixed. Not pretty, not understood, but efficient (for a while.)

6 March 2003

Included the FSF FDL licence.

2 Mars 2003

Included links towards the configuration files; random cosmetic changes.

### 3 Hardware configuration

The installation is performed on the following configuration:

```

Model      Dell Latitude C840
Processor
           Mobile Intel(R) Pentium(R) 4 - M CPU 2.00GHz
Memory     512 Mo (1x512)
Video      GeForce4 440 Go card
Screen     TFT 15" 1600x1200
Hard drive
           40Go 5400 rpm
CD drive   Combo DVD/CD-RW
Network    Integrated 3Com 905?
Modem      Integrated modem based on i810 (Intel ICH3)

```

As an example, here is the output of `lspci -v` on a 2.4.20 kernel:

```

fermat:~# lspci -v
00:00.0 Host bridge: Intel Corp. 82845 845 (Brookdale) Chipset Host Bridge (rev 04)
          Flags: bus master, fast devsel, latency 0
          Memory at e8000000 (32-bit, prefetchable) [size=64M]
          Capabilities: [e4] #09 [d104]
          Capabilities: [a0] AGP version 2.0

00:01.0 PCI bridge: Intel Corp. 82845 845 (Brookdale) Chipset AGP Bridge (rev 04) (prog-
if 00 [Normal decode])
          Flags: bus master, 66Mhz, fast devsel, latency 32
          Bus: primary=00, secondary=01, subordinate=01, sec-latency=32
          I/O behind bridge: 0000c000-0000cfff
          Memory behind bridge: fc000000-fdffffff
          Prefetchable memory behind bridge: d8000000-e7ffffff

00:1d.0 USB Controller: Intel Corp. 82801CA/CAM USB (Hub #1) (rev 02) (prog-
if 00 [UHCI])
          Subsystem: Intel Corp.: Unknown device 4541
          Flags: bus master, medium devsel, latency 0, IRQ 11
          I/O ports at bf80 [size=32]

00:1d.2 USB Controller: Intel Corp. 82801CA/CAM USB (Hub #3) (rev 02) (prog-
if 00 [UHCI])
          Subsystem: Intel Corp.: Unknown device 4541
          Flags: bus master, medium devsel, latency 0, IRQ 11
          I/O ports at bf20 [size=32]

00:1e.0 PCI bridge: Intel Corp. 82801BAM/CAM PCI Bridge (rev 42) (prog-if 00 [Nor-
mal decode])
          Flags: bus master, fast devsel, latency 0
          Bus: primary=00, secondary=02, subordinate=10, sec-latency=32
          I/O behind bridge: 0000e000-0000ffff

```

Memory behind bridge: f4000000-fbffff

00:1f.0 ISA bridge: Intel Corp. 82801CAM ISA Bridge (LPC) (rev 02)

Flags: bus master, medium devsel, latency 0

00:1f.1 IDE interface: Intel Corp. 82801CAM IDE U100 (rev 02) (prog-if 8a [Master SecP PriP])

Subsystem: Intel Corp.: Unknown device 4541

Flags: bus master, medium devsel, latency 0, IRQ 11

I/O ports at 01f0 [size=8]

I/O ports at 03f4

I/O ports at 0170 [size=8]

I/O ports at 0374

I/O ports at bfa0 [size=16]

[virtual] Memory at 20000000 (32-bit, non-prefetchable) [size=1K]

00:1f.5 Multimedia audio controller: Intel Corp. 82801CA/CAM AC'97 Audio (rev 02)

Subsystem: Cirrus Logic: Unknown device 5959

Flags: bus master, medium devsel, latency 0, IRQ 11

I/O ports at d800 [size=256]

I/O ports at dc80 [size=64]

00:1f.6 Modem: Intel Corp. 82801CA/CAM AC'97 Modem (rev 02) (prog-if 00 [Generic])

Subsystem: PCTel Inc: Unknown device 4c21

Flags: bus master, medium devsel, latency 0, IRQ 11

I/O ports at d400 [size=256]

I/O ports at dc00 [size=128]

01:00.0 VGA compatible controller: nVidia Corporation NV17 [GeForce4 440 Go] (rev a3) (prog-if 00 [VGA])

Subsystem: Dell Computer Corporation: Unknown device 00d5

Flags: bus master, VGA palette snoop, 66Mhz, medium devsel, latency 248, IRQ 11

Memory at fc000000 (32-bit, non-prefetchable) [size=16M]

Memory at e0000000 (32-bit, prefetchable) [size=128M]

Memory at dff80000 (32-bit, prefetchable) [size=512K]

Expansion ROM at 80000000 [disabled] [size=128K]

Capabilities: [60] Power Management version 2

Capabilities: [44] AGP version 2.0

02:00.0 Ethernet controller: 3Com Corporation 3c905C-TX/TX-M [Tornado] (rev 78)

Subsystem: Dell Computer Corporation: Unknown device 00d5

Flags: bus master, medium devsel, latency 32, IRQ 11

I/O ports at ec80 [size=128]

Memory at f8fffc00 (32-bit, non-prefetchable) [size=128]

Expansion ROM at f9000000 [disabled] [size=128K]

Capabilities: [dc] Power Management version 2

02:01.0 CardBus bridge: Texas Instruments PCI4451 PC card Cardbus Controller

Subsystem: Dell Computer Corporation: Unknown device 00d5

Flags: bus master, medium devsel, latency 168, IRQ 11

Memory at 20001000 (32-bit, non-prefetchable) [size=4K]

Bus: primary=02, secondary=03, subordinate=06, sec-latency=176

Memory window 0: 20400000-207ff000 (prefetchable)  
Memory window 1: 20800000-20bff000  
I/O window 0: 00004000-000040ff  
I/O window 1: 00004400-000044ff  
16-bit legacy interface ports at 0001

02:01.1 CardBus bridge: Texas Instruments PCI4451 PC card Cardbus Controller

Subsystem: Dell Computer Corporation: Unknown device 00d5  
Flags: bus master, medium devsel, latency 168, IRQ 11  
Memory at 20002000 (32-bit, non-prefetchable) [size=4K]  
Bus: primary=02, secondary=07, subordinate=0a, sec-latency=176  
Memory window 0: 20c00000-20fff000 (prefetchable)  
Memory window 1: 21000000-213ff000  
I/O window 0: 00004800-000048ff  
I/O window 1: 00004c00-00004cff  
16-bit legacy interface ports at 0001

02:01.2 FireWire (IEEE 1394): Texas Instruments PCI4451 IEEE-1394 Controller (prog-if 10 [OHCI])

Subsystem: Dell Computer Corporation: Unknown device 00d5  
Flags: bus master, medium devsel, latency 32, IRQ 11  
Memory at f8ff0000 (32-bit, non-prefetchable) [size=2K]  
Memory at f8ff8000 (32-bit, non-prefetchable) [size=16K]  
Capabilities: [44] Power Management version 2

## 4 Procedure

First of all, I removed all the stickers relating to some software I never used on this machine. (Replace them with one of [these](#).) Then I examined the BIOS, and used the following settings:

- Boot selection

I use boot on CD first, followed by boot on hard drive.

- Energy saving

I wasn't sure of the quality of APM or ACPI support, so I used a rather expensive energy saving mode: constant CPU speed, no S2D, closed screen will not shut down the laptop.

Then, I booted on a Debian CD bought along with the magazine *Planète Linux*, which publishes a special edition for each important milestone of Debian.

I chose the flavour **bf24** for maturity and driver availability reasons.

### 4.1 Partitionning

I partitionned the 40Gb hard disk as following:

```
hda1 /boot 16Mb
hda2 / 1Gb
hda3 swap 516Mb
hda5 /usr 6Gb
hda6 /var 1Gb
hda7 /home rest
```

I set up all the partitions to **Ext3** (except **swap** of course). It might actually be useless, or cause problems for `/boot` and `/usr`. Make your own decision.

I also performed a full surface test; this allows to check that the laptop has not been too mishandled while shipping.

### 4.2 Modules

The installation allows to choose the modules that are loaded at start-up. I took this opportunity to change what I think are the most important ones:

- The network driver

The `3c59x` module loaded fine with no parameters. I included it in the kernel later on.

- The sound driver

The `i810` module worked very well, although I do not think I am using it at its best. In fact, `festival` told me I had to use `sox` for sound output.

### 4.3 Installing the packages

It is advisable to set up an Ethernet network to enable DHCP from the start. This can be configured after installation (`man interfaces`), but it's more convenient to do it during the installation.

I chose to install almost all the development packages, X, and some servers such as PostgreSQL and Apache. Of course you should adapt the selection to your own needs.

A very important point: think in advance of the name you want to give to your laptop. There is nothing worse than staring at an empty blue dialog box, and realising that this is where you will lose most of your time.

## 4.4 First customisations

This is where the real customisation of the laptop starts. In my opinion, if you have an Internet connection, the first thing to do is to update the packages.

This can be done during the installation (by using a FTP or HTTP source). As I was behind a firewall, I modified my `/etc/apt/sources.list` as followed, instead.

```
deb http://http.us.debian.org/debian stable main contrib non-free
deb http://http.us.debian.org/debian testing main contrib non-free
# deb http://http.us.debian.org/debian unstable main contrib non-free
deb http://non-us.debian.org/debian-non-US stable/non-US main contrib non-free
deb http://non-us.debian.org/debian-non-US testing/non-US main contrib non-free
# deb http://non-us.debian.org/debian-non-US unstable/non-US main contrib non-free
deb http://security.debian.org stable/updates main contrib non-free

deb http://marillat.free.fr/ stable main
deb http://marillat.free.fr/ testing main
# deb http://marillat.free.fr/ unstable main

# Uncomment if you want the apt-get source function to work
deb-src http://http.us.debian.org/debian stable main contrib non-free
# deb-src http://non-us.debian.org/debian-non-US stable non-US
```

The changes consist in inserting *testing* in addition to *stable*, and supressing the lines relating to the CD-ROM. **Christian Marillat**'s site, (<http://marillat.free.fr/>) gives access to mplayer and mencoder later on.

Remember to make a backup copy, or use emacs' wonderful `version-control` option. (Note from the translator: if your editor is just an editor instead of being an operating system, using CVS on all of /etc is a good idea too.)

After editing `/etc/apt/sources.list`, issue the two magical commands:

```
apt-get update
apt-get dist-upgrade -u
```

and your system will update itself with the latest security patches and the latest package versions.

Go get a coffee or a beer as this is a rather long operation. Tea also works for our Commonwealth readers.

## 4.5 Compiling the kernel

To get the best performance out of the graphics card and the hardware in general, it is advisable to compile the kernel and the relevant modules. The following commands will help a long way:

```
apt-get install libncurses5-dev
apt-get install kernel-package
apt-get install kernel-source-2.4.20
```

`libncurses5-dev` is only to allow `make menuconfig` while configuring the kernel. You may also want to choose a different kernel version. The most recent one is usually a good choice.

You should then decompress the files and prepare the nVidia modules:

```
cd /usr/src
tar xjvf kernel[TAB]
```

```
ln -s kern[TAB] linux
apt-get -t unstable install nvidia-glx-src nvidia-kernel-src
apt-get install xlibmesa-dev
tar zxvf nvidia-kern[TAB]
```

The nVidia drivers are fetched with ‘-t unstable’, as only unstable support the GeForce4 440 Go card as of this writing.

It’s now time to make [menu|x|]config in ‘/usr/src/linux’ to configure your kernel. Here are some tips:

- Enable module support. It makes it easier to start things up.
- Remember to set "Dell laptop support".
- Activate network and PCI support. ISA support is useless.
- PCMCIA support will also be useful.
- I activated ACPI, but only APM works well.
- Activate Netfilter, especially if you will use Wifi. . . A firewall on a laptop is no luxury.
- IDE/ATAPI CD-ROM support is useful, but you will need to manage the drive as a SCSI device.
- Therefore. . . SCSI emulation support.
- SCSI support, SCSI CD-ROM support, SCSI generic support, but no "low-level" drivers.
- IEEE1394 and OHCI-1394, and anything else you want, but better off including it as a module.
- Network card: 3c590/3c900 series.
- Activate PPP and friends if needed.
- To get IrDA, I didn’t activate LAN nor NET.
- The sound card is an Intel ICH (i8xx).

I also recommend getting an USB mouse, and therefore set USB in the kernel; it works very well with XFree4 and hotplug.

Now compile the kernel:

```
cd /usr/src/linux
make-kpkg clean
make-kpkg kernel_image
cd ..;dpkg -i kernel-image-*.deb
cd linux; make-kpkg modules_image
cd /usr/src/nvidia-glx[TAB]; dpkg-buildpackage -us -uc
cd ..; dpkg -i nvidia-*.deb
```

and reboot. . . .

You can also check my [configuration file](#) for reference.

## 5 Specific Hardware Support

Using this configuration, the screen might not support sleep properly; the fans can run in strange ways (**Be careful of overheating!**); closing the screen might crash X; the CD burner might not work; . . .

Here is how I solved some of these problems:

### 5.1 Closing the screen

The nVidia driver is only supposed to work using ACPI. It does not answer APM requests from the CPU. A quick glance to the source (and Google) shows that 'nv.c' in '/usr/src/modules/nvidia-kernel-1.0.4191/NVIDIA\_kernel-1.0-4191.tar.gz' has a directive `#if 0` in which the two case `PM_*` return 1. Replace this with `return 0`; and comment the call to `rm_power_management`.

Of course, you also needed to change `#if 0` to `#if 1` but you will have corrected, won't you?

If you are using `make-kpkg`, you will need to re-create a tarball including this change. Otherwise, you should be good enough to find out how to do it yourself :)

With this single change, the laptop soars to all its potential: no more reboots, no more X freezes, and you no longer need to leave X to `rmmmod nvidia` and close the laptop. Wonderland.

Here is my [XFree configuration file](#). There is a harmless mistake in it. . . You will have to find it :)

### 5.2 Fans and function keys

After unsuccessful attempts to use `lm-sensors`, I discovered a package called `i8kutils` which solved all my problems:

```
apt-get install i8kutils
```

Some changes to '/etc/i8kbuttons' and '/etc/i8kmon' are required:

```
# Sample /etc/i8kbuttons configuration file (used by /etc/init.d/i8kbuttons).

# Change these sample commands with your mixer commands!!!
I8KBUTTONS_UP_CMD="aumix -v +5"
I8KBUTTONS_DOWN_CMD="aumix -v -5"
I8KBUTTONS_MUTE_CMD="/bin/mute"

# Poll interval (milliseconds)
I8KBUTTONS_TIMEOUT=100

# Autorepeat interval (milliseconds)
I8KBUTTONS_REPEAT=0

# end of file
```

I manage sound using `aumix-gtk` and `gkrellm2` along with its plugin `gkrellm-volume2`. As `aumix` had no mute feature, I created a small script '/bin/mute' containing:

```
#!/bin/sh
# Swap mute...
#
```

```

VOL=/etc/last_aumix

# If the file exists, set to internal value and erase
if [ -f $VOL ]
then
    aumix -v 'cat $VOL'
    /bin/rm $VOL
else
    aumix -v q|sed -e 's/.*,//'>$VOL
    aumix -v 0
fi

```

### 5.3 Burner

Two settings are necessary to drive the burner correctly. First, in `/etc/lilo.conf`:

```

append="hdb=ide-scsi"
and in /dev:
ln -s /dev/sr0 /dev/cdrom
ln -s /dev/sr0 /dev/dvd

```

Follow this with a reboot. Note how we only have rebooted twice so far, and this changes could be made before the first reboot. Some other operating system will have you reboot after moving the mouse :-)

It is then up to you to choose between `grip`, `cdrecord`, `cdrdao`, or any other tool of your choice.

### 5.4 Modem

Just follow this blindly:

```

wget -P /usr/src http://linmodems.technion.ac.il/pctel-linux/pctel-0.9.6.tar.gz
./configure --with-hal=i8xx
make
make install

# To test
modprobe pctel
modprobe ptserial

# For the rest of your life
echo "alias char-major-62 ptserial" >> /etc/modutils/pctel
update-modules

```

### 5.5 IrDA

Supporting the link between a Palm and JPilot didn't cause any problems. On the other hand, I recently acquired an infra-red-enabled phone, and this didn't work out of the box.

The first step was to install several small packages, which may or may not help.

```

apt-get install lirc
apt-get install ircp

```

```
apt-get install gsm-utils
apt-get install scmxx
```

ircp managed to talk directly to the phone, and to transfer the address book, images, themes etc. . . .

My objectives with the phone are two-fold: I want to be able to save the contents of my phone to disk; and, I want to connect to the network using the GPRS mode. This is where the problems start, as my phone is a SunyEricsson T68i, which is known to be buggy. Kudos to irdadump to have helped me find this out.

The IrOBEX mode works just fine. However, when using IrCOMM the phone emits bad parameters: the window size and the minimum response delay are wrong. I caught this second parameter while examining the communication with irdadump:

```
14:53:57.741656 snrm:cmd ca=fe pf=1 2cc4b1b4 > 29c42130 new-ca=ae
      LAP QoS: Baud Rate=4000000bps Max Turn Time=500ms Data Size=2048B
Window Size=7 Add BOFS=0 Min Turn Time=1000us Link Disc=12s (33)
14:53:57.877021 ua:rsp ca=ae pf=1 2cc4b1b4 < 29c42130
      LAP QoS: Baud Rate=1152000bps Max Turn Time=500ms Data Size=256B Window
Size=3 Add BOFS=0 Min Turn Time=0us Link Disc=12s (31)
```

The last line indicates a minimum response time of 0, which is illegal. Jean Tourrilhes [http://www.hpl.hp.com/personal/Jean\\_Tourrilhes/IrDA/IrDA.html](http://www.hpl.hp.com/personal/Jean_Tourrilhes/IrDA/IrDA.html), suggests using this command:

```
echo 1000 > /proc/sys/net/irda/min_tx_turn_time
```

On the other hand, the bad window size cannot be corrected with kernels earlier than 2.5.42. Using the specified window size of 3, the phone only reacts as:

```
14:53:57.914408 rr:rsp < ca=ae pf=1 nr=4 (2)
14:53:57.914453 rr:cmd > ca=ae pf=1 nr=2 (2)
14:53:57.924388 rr:rsp < ca=ae pf=1 nr=4 (2)
14:53:57.965741 rr:cmd > ca=ae pf=1 nr=2 (2)
```

endlessly. From kernel 2.5.42 onwards, the window size can explicitly be set by `echo 1 > /proc/sys/net/irda/max_tx_window`. There is however a patch for 2.4 kernels available here: [http://www.hpl.hp.com/personal/Jean\\_Tourrilhes/IrDA/ir251\\_qos\\_param-2.diff](http://www.hpl.hp.com/personal/Jean_Tourrilhes/IrDA/ir251_qos_param-2.diff). This is rather easy to install, and works well.

The settings for the GPRS link is well documented on [http://kotinetti.suomi.net/mcfrisk/linux\\_gprs.html](http://kotinetti.suomi.net/mcfrisk/linux_gprs.html). ■

## 6 Outstanding issues

Some minor irritating points are still not ironed out. If you have any suggestion, please let me know...

- Keyboard speed (partially resolved)

When waking from `SUSPEND` mode, the keyboard speed settings are not restored, despite installing a script `'30kbrate'` in `'/etc/apm/event.d'`. It is always executed upon wake-up, but only works sometimes.

Running `kbrate` twice in `'30kbrate'` fixes the problem. I don't know why. Be aware that `apt-get dist-upgrade` might touch this file in your back.

- Processor speed

The processor remains at the speed at which it started. If the main supply was plugged in, it will run at 2GHz; if it booted on battery, then it will only run at 1.2GHz.

`⌘+⌘` (on a French keyboard) allows me to switch between the two frequencies.

- Strange hard drive noises

The hard drive always makes strange little noises, as if the heads were banging from one side to the other, whether there is disk access or not. These come every 30 seconds or so.

(Note from the translator: I have a feeling that the hard drive in my Toshiba Satellite 3000 does something similar, although not on such a regular basis. As this Toshiba runs under Win XP almost exclusively, that may point out some actual hardware problem that has nothing to do with Linux, on a whole range of laptop hard disks. To be investigated...)

- BIOS calls

Calling the BIOS using `⌘+⌘` under X freezes the laptop. Same goes for checking the battery state using `⌘+⌘`

- Television output

I haven't tried it. If you tell me how, I'll test it and update this document.

# Appendix A GNU Free Documentation License

Version 1.2, November 2002

Copyright © 2000,2001,2002 Free Software Foundation, Inc.  
59 Temple Place, Suite 330, Boston, MA 02111-1307, USA

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

## 0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document *free* in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially. Secondly, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of “copyleft”, which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

## 1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The “Document”, below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as “you”. You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A “Modified Version” of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A “Secondary Section” is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document’s overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The “Invariant Sections” are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections then there are none.

The “Cover Texts” are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A “Transparent” copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not “Transparent” is called “Opaque”.

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The “Title Page” means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, “Title Page” means the text near the most prominent appearance of the work’s title, preceding the beginning of the body of the text.

A section “Entitled XYZ” means a named subunit of the Document whose title either is precisely XYZ or contains XYZ in parentheses following text that translates XYZ in another language. (Here XYZ stands for a specific section name mentioned below, such as “Acknowledgements”, “Dedications”, “Endorsements”, or “History”.) To “Preserve the Title” of such a section when you modify the Document means that it remains a section “Entitled XYZ” according to this definition.

The Document may include Warranty Disclaimers next to the notice which states that this License applies to the Document. These Warranty Disclaimers are considered to be included by reference in this License, but only as regards disclaiming warranties: any other implication that these Warranty Disclaimers may have is void and has no effect on the meaning of this License.

## 2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

## 3. COPYING IN QUANTITY

If you publish printed copies (or copies in media that commonly have printed covers) of the Document, numbering more than 100, and the Document’s license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible.

You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a computer-network location from which the general network-using public has access to download using public-standard network protocols a complete Transparent copy of the Document, free of added material. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

#### 4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

- A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.
- B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has fewer than five), unless they release you from this requirement.
- C. State on the Title page the name of the publisher of the Modified Version, as the publisher.
- D. Preserve all the copyright notices of the Document.
- E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.
- F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.
- G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in the Document's license notice.
- H. Include an unaltered copy of this License.
- I. Preserve the section Entitled "History", Preserve its Title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section Entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.

- J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the “History” section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.
- K. For any section Entitled “Acknowledgements” or “Dedications”, Preserve the Title of the section, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein.
- L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.
- M. Delete any section Entitled “Endorsements”. Such a section may not be included in the Modified Version.
- N. Do not retitle any existing section to be Entitled “Endorsements” or to conflict in title with any Invariant Section.
- O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version’s license notice. These titles must be distinct from any other section titles.

You may add a section Entitled “Endorsements”, provided it contains nothing but endorsements of your Modified Version by various parties—for example, statements of peer review or that the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

## 5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled “History” in the various original documents, forming one section Entitled “History”; likewise combine any sections Entitled

“Acknowledgements”, and any sections Entitled “Dedications”. You must delete all sections Entitled “Endorsements.”

## 6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

## 7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, is called an “aggregate” if the copyright resulting from the compilation is not used to limit the legal rights of the compilation’s users beyond what the individual works permit. When the Document is included in an aggregate, this License does not apply to the other works in the aggregate which are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one half of the entire aggregate, the Document’s Cover Texts may be placed on covers that bracket the Document within the aggregate, or the electronic equivalent of covers if the Document is in electronic form. Otherwise they must appear on printed covers that bracket the whole aggregate.

## 8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License, and all the license notices in the Document, and any Warranty Disclaimers, provided that you also include the original English version of this License and the original versions of those notices and disclaimers. In case of a disagreement between the translation and the original version of this License or a notice or disclaimer, the original version will prevail.

If a section in the Document is Entitled “Acknowledgements”, “Dedications”, or “History”, the requirement (section 4) to Preserve its Title (section 1) will typically require changing the actual title.

## 9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided for under this License. Any other attempt to copy, modify, sublicense or distribute the Document is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

## 10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See <http://www.gnu.org/copyleft/>.

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License “or any later version” applies to it, you have the option of following the terms and conditions either of that specified

version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation.

### A.0.1 ADDENDUM: How to use this License for your documents

To use this License in a document you have written, include a copy of the License in the document and put the following copyright and license notices just after the title page:

```
Copyright (C) year your name.
Permission is granted to copy, distribute and/or modify this document
under the terms of the GNU Free Documentation License, Version 1.2
or any later version published by the Free Software Foundation;
with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts.
A copy of the license is included in the section entitled ‘‘GNU
Free Documentation License’’.
```

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts, replace the “with...Texts.” line with this:

```
with the Invariant Sections being list their titles, with
the Front-Cover Texts being list, and with the Back-Cover Texts
being list.
```

If you have Invariant Sections without Cover Texts, or some other combination of the three, merge those two alternatives to suit the situation.

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.