Nvidia OpenGL Configuration mini−HOWTO

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Revision History

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This mini−HOWTO is about how to install the OpenGL drivers for Nvidia graphics cards on Linux. In addition to just installing the Nvidia drivers, this mini−HOWTO also explains how to install XFree86, the OpenGL Utility library (part of Mesa), the OpenGL Utility Toolkit (glut), the full set of OpenGL manpages, Qt and its OpenGL extension, and Java and its Java 3D extension so that a user can have a complete runtime and development environment for OpenGL applications on Linux.

Note that some of this material may be out of date. The author has attempted to update this material but has not had time to test all the procedures. Nevertheless, this document should still provide a decent overview of what is involved. If you spot errors please contact the author.

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New Versions of this Document

The latest version of this mini−HOWTO can be found at:

http://www.linuxdoc.org/HOWTO/mini/Nvidia−OpenGL−Configuration/

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Contributors

I thank the following contributors for their input into this document:

- Jan De Luyck (jandeluyck at gmx.net) –– Provided information about tweaking `os-registry.c` to change AGP settings and how to monitor the nv settings with **cat /proc/nv/card0**. Thanks *!*

Chapter 1. Introduction

The installation of the NVIDIA drivers under Linux can be quite easy in itself. However, there is a little more to it sometimes than just unpacking the driver files.

Since certain versions of the NVIDIA drivers require upgrading your XFree86 to work, I've included some material on installing XFree86. If upgrading XFree86 is necessary for you, you can read this document but also carefully read the information at XFree86.org.

The NVIDIA driver is only concerned with installing the OpenGL libGL library. But since there is more to a complete OpenGL installation than just libGL, I cover the installation of defacto standard OpenGL add−on libraries like GL Utility (libGLU) and GL Utility Toolkit (libglut).

Going a little beyond the basics, I cover the installation of some other libraries you might want to consider: TrollTech's Qt C++ Library and the Java language Java 3D API.

Chapter 2. Download the software packages

2.1. Linux Kernel >= 2.2.12 Required

First of all, the OpenGL drivers for the Nvidia cards currently require a system with Linux kernel 2.2.12 or later. Recent releases of kernel 2.4.x are supported and are recommended since most new development happens in the 2.4 kernels. If you don't have it, then you will have to upgrade your system's Linux kernel; see The Linux Kernel HOWTO for details.

The Linux kernel can be downloaded at: http://www.kernel.org/

2.2. XFree86 4.0 or later

The current version of XFree86 is 4.2.0 as of this writing. It can be downloaded as source or binaries. It is generally recommended to download the binaries these days. See http://www.XFree86.org for the lastest official information on installation of XFree86. Later in this document, I describe only the very basic procedure for compiling and installing from the source.

XFree86 source code comes in three files:

- X420src−1.tgz
- X420src−2.tgz
- X420src−3.tgz
- doctools−1.3.tgz
- utils.tgz

Doctools is the DocBook SGML package used by XFree86 to prepare the X documentation. Utils contains the source for the "extract" program, which is a modified GNU tar with gzip support. Extract is only important if you are installing a binary distribution of XFree86 on top of your existing XFree86 to upgrade it. Extract unlinks old existing files that are being extracted/updated instead of skipping them. Extract comes with the binary distributions so utils.tgz is only important for making your own binary distribution.

You can download XFree86 from its ftp site: ftp://ftp.xfree86.org/

XFree86 includes GLX, the OpenGL X interface functions. Each window system has to provide the platform−specific interfaces between OpenGL and the window system for mapping a GL rendering context to a window system widget. Recent versions of XFree86, like version 4.2.0, now also include libGLU and the OpenGL manual pages.

2.3. OpenGL man pages

XFree86 prior to version 4.2.0 comes with only the GLX and (maybe) GLU man pages. If you wanted a full set of OpenGL man pages, you had to get them yourself.

- mangl.tar.Z
- manglu.tar.Z

- manglx.tar.Z (you don't need this one)

If you are using XFree86 4.2.0 or later, you should already have the manglx OpenGL interface extension man pages, mangl OpenGL library man pages, and the manglu GL Utility library pages too. If you are using XFree86 prior to 4.2.0, you'll have to see what you have included with your XFree86 version and get some of the packages above. As time goes on, XFree86 has been including more of these manual pages and other standard OpenGL add−on libraries.

These packages can be found at: ftp://ftp.sgi.com/sgi/opengl/doc/

These man page packages are in a format ready to be unpacked into the XFree86 source distributions (if needed/missing), see below.

2.4. Mesa 3D

- MesaLib−4.0.1.tar.gz
- MesaDemos−4.0.1.tar.gz

http://mesa3d.sourceforge.net/

Mesa is the library that provides the foundation for the 3D support included in XFree86. Originally, Mesa included a software−only libGL that only claims to be "similar to that of OpenGL." Mesa now also supports hardware acceleration for a growing number of cards (see their site for details). The Mesa package also includes an implementation of the libGLU Utility library and the libglut GL Utility Toolkit library. Some versions of XFree86 only included the libGL from Mesa and some header files. With recent releases of XFree86, like 4.2.0, more has been added from Mesa, like libGLU and the manual pages. libglut may still be missing from your XFree86 distribution, so you may still like to get it from the Mesa distribution or from the GLUT distribution directly.

As shipped, XFree86 will support software OpenGL rendering (painfully slow) using the Mesa libGL. It may also support hardware accelerated OpenGL for some cards that have a fully open source driver. But for NVIDIA, the subject of this document, there is no fully open sourced hardware accelerated OpenGL driver included in XFree86. The NVIDIA GLX/OpenGL driver we download from NVIDIA.com is a binary, closed source driver that is a drop−in hardware accelerated replacement for the Mesa libGL.so file.

libGLU is a library built on top of libGL to provide some higher−level functions for applications. OpenGL itself, libGL, is considered a low−level library. GLU is a standard part of most OpenGL installations and many programs make use of it.

MesaDemos provides many OpenGL demo programs and, more importantly, the GL Utility Toolkit (libglut) library. GLUT provides a window system independent interface between OpenGL and any supported window system. For instance, on the X Window System, it hides the details of using glX functions to setup a window. Programmers can write code once and can compile it to work on MS Windows or X, etc provided that a GLUT library is available on the target platform. Like libGLU, libglut is a standard part of most OpenGL installations and is required by many programs.

While GLUT is bundled with MesaDemos, it is also available as separate packages:

glut−3.7.tar.gz glut_data−3.7.tar.gz

from http://www.opengl.org/developers/documentation/glut/index.html

You may use *either* the GLUT included with MesaDemos (preferred and easier) or the GLUT from its project website. Don't install both! It's recommended at this time to go with the GLUT packaged with MesaDemos, but instructions on how to install the other GLUT are still provided in the next section as an option. Note that MesaDemos does not include the glut manpages, so you may want to download the project GLUT package just to install its man pages.

2.5. Qt

qt−x11−2.2.4.tar.gz or later version

http://www.troll.no/

Qt is a cross−platform GUI library that makes it easy to create X applications with standard GUI elements (widgets) like menubars, scollbars, dropdown lists, checkboxes, buttons, multiple document interface, and many other GUI things. Using Qt, a program can be compiled for both MS Windows and X without changing any code. Its a very popular GUI library and is used to create the core libraries of KDE (http://www.kde.org/).

Qt has functions (previously as an extension in $QTDIR/extensions/opengl) for OpenGL that provides for creating OpenGL rendering contexts in Qt windows. This provides some alternative to both GLUT and using the glX functions directly, plus the added benefit of full access to the excellent Qt widgets and cross−platform portability.

This is useful if you want to compile or develop programs based on Qt (e.g., KDE2 and its apps).

2.6. NVIDIA drivers (Mesa libGL replacement)

- NVIDIA_kernel−1.0−2314.tar.gz
- NVIDIA_GLX−1.0−2313.tar.gz

Note that XFree86 4.0.1 and later is required with driver 0.9−6 and later. If you have XFree86 4.0.0, then you'll have to download the older 0.9−4 version. You should try to use the lastest XFree86 and NVIDIA drivers.

Download the drivers at: http://www.nvidia.com/

See the updated FAQ at Nvidia.com while you are downloading. It has important installation information not in this HOWTO.

The NVIDIA drivers provide a kernel driver: /lib/modules/kernel.version.number/video/NVdriver and libGL.so and libGLcore.so files that go into /usr/lib/ to replace and Mesa ones that might be in there. libGL.so is OpenGL. These files are Nvidia's own hardware accelerated OpenGL implementation.

2.7. Java 2 SDK, Java 3D extension, and Java PlugIn for Netscape (optional)

The following file is available at http://www.blackdown.org/:

- java3d−1.2.1_01−fcs−linux−i386−sdk.tar.bz2

Note that to install these Java files, your system needs to have glibc 2.1.3 or later. To check your version of glibc:

```
                ls −l /lib/libc*
```

On rpm−based systems (like RedHat and Mandrake), you can try:

```
                rpm −q glibc
```

To use any Java on your system, you must also install the Java Software Development Kit (JSDK) 1.3.1 or later from java.sun.com. The Blackdown version of the JSDK will also work.

The Java 3D media extension contains many 3D demo programs/applets and takes advantage of the OpenGL hardware acceleration on the system. The Java 3D API uses the OpenGL API internally. The demos run as normal Java applications and also as applets inside Netscape via the Java PlugIn, or inside KDE's Konqueror by directly using the Java runtime (JRE).

Chapter 3. Install Software

3.1. README and INSTALL files

During the installation of all these packages, always read the README and INSTALL files etc. that come with them for the lastest, most authoritative information. Take some time to browse the website for each package for additional documentation.

3.2. Install XFree86

Installation of the software packages requires root login, which can be obtained easily via the superuser/setuser command: **su –** (see, **man su**).

The following explains the installation of XFree86 from source in only the most basic terms. Make sure to read all the XFree86 documentation to learn about special options.

If you have a version of XFree86 installed already, you may want to move it or delete it. However, installing over an existing X is generally OK and preserves any programs or libraries you might have installed into the X directories (not that you should really do that):

```
cd /usr
mv X11R6 X11R6-old
cd /etc
mv X11 X11-old

# you may have an X directory in /var also
cd /var
mv X11R6 X11R6-old
```

If these locations are not correct for your distribution of Linux, you will have to look around your filesystem a bit – try looking in `/var`

```
cd /usr/src
mkdir release
cd release
tar -xvzf X420src-1.tgz
tar -xvzf X420src-2.tgz
tar -xvzf X420src-3.tgz
tar -xvzf doctools-1.3.tar.gz
```

If you are using an old version of XFree86 for some reason, you may want to use the man page packages. XFree 4.2.0 and later has all these man pages already. Skip using the man page packages if you don't need them. Check in /usr/src/release/xc/doc/man to see what all is included with your XFree86.

```
# unpack the man pages if they are missing.
cd /usr/src
tar -xvzf mangl.tar.Z
tar -xvzf manglu.tar.Z
```

A file has to be edited to allow these man pages to compile/install with the rest of the distribution:

```
        cd /usr/src/release/xc/doc/man/GL
        # Edit the file: Imakefile
        #       SUBDIRS = glx gl glu
```

When you unpacked the `man*.tar.Z` files above, two new directories where added: `gl glu`

```
        cd /usr/src/release
        cd doctools

        # Having this variable set confuses the sgml docs build.
        # With it unset, the build uses the proper defaults.
        unset $SGML_CATALOG_FILES

        make
        make install

        # Note: doctools installs the perl program sgmlfmt to
        # /usr/local/bin.  It looks for the perl executable
        # at /usr/local/bin/perl.  If perl is installed
        # on your system at /usr/bin/perl, then it will not
        # find perl and the sgml docs build will fail!
        # Make a symlink if needed (or edit the script):
        cd /usr/local/bin
        ln −s /usr/bin/perl perl

        cd /usr/src/release
        cd xc/config/cf
        vi host.def
        # add the following three lines to host.def:
        #       #define HasSgmlFmt YES
        #       #define BuildAllDocs YES
        #       #define HasZlib YES
        # See the README file in doctools and xc/config/cf.
        # HasZlib YES instructs XFree86 not to build and install
        # it's own old zlib.  If you do not have zlib installed
        # (check /usr/lib/libz*), then omit the HasZlib line or
        # go download it and install it first:
        #       http://www.info−zip.org/pub/infozip/zlib/
        # A common zlib conflict occurs when a system already
        # has zlib installed and XFree86 installs it's also.
        # In this case, deleting /usr/X11R6/lib/libz.a fixes
        # the problem.

        cd /usr/src/release/xc
        make World
        # before installing, make sure you have moved
        # or deleted prior installation of X
        # unless you are sure you want to just overwrite
        make install
        make install.man

        # make symlinks
        cd /usr/include
        ln −s ../X11R6/include/DPS DPS
        ln −s ../X11R6/include/GL GL
```

```
        ln -s ../X11R6/include/X11 X11
        ln -s ../X11R6/include/bitmaps bitmaps
        cd ..
        ln -s X11R6 X11
```

Add `/usr/X11R6/lib` to your `/etc/ld.so.conf` file, then run the command **ldconfig** to update `/etc/ld.so.cache` so the libraries will be visible.

The GL/GLX/GLU HTML documentation is located at `/usr/src/release/xc/doc/hardcopy/GL`. This directory can be copied as follows:

```
                cd /usr/src/release/xc/doc/hardcopy
                cp -r GL /usr/X11R6/lib/X11/doc/html
```

The `index.html` file in the docs might point to `manindex5x.html`, but the filename may actually be `manindex5.html`. Just make a symlink to fix it if needed:

```
                cd /usr/X11R6/lib/X11/doc/html
                ln -s manindex5.html manindex5x.html
```

When X is up and running (later), try using the **xman** program to see that the gl,glx,glu and glut **man** pages are in section 3. If you have KDE2, khelpcenter allows **man**−page browsing.

3.3. Install Mesa

Note: This gives you the `libGLU*` and `libglut*` files that may be missing in XFree86. XFree86 used to only come with the OpenGL core library, `libGL` (based on Mesa). This also installs Mesa's `libGL`, but we will delete that since it is to be replaced by the Nvidia libGL.

You should look in `/usr/X11R6/lib` to see if you already have libglut.* and libGLU.*. If you do, you can skip installing Mesa. Recent releases of XFree86 have been including more of Mesa as standard.

It's best to uninstall any old Mesa version you may have installed before installing a new Mesa. Uninstalling software can be a dangerous operation, so know what you are doing! If you have software depending on your old Mesa, you might need to keep it and just install the new Mesa along with it.

To completely uninstall any Mesa libs that may have come with Slackware:

```
                removepkg mesa
```

For **rpm**−based systems (like RedHat and Mandrake), try:

```
                # see what will be removed first
                rpm -e --test Mesa | less
                # if ok, proceed
                rpm -e Mesa
```

For Debian, you can try:

```
                apt-get remove Mesa
```

Procedures vary for other distributions. If there is no clear way to uninstall an existing Mesa, then at least confirm where it is installed: normally either under `/usr` or `/usr/local`. The example below assumes that Mesa is installed (or going to get installed) under `/usr`. Installing over an old version is probably harmless. Look for `/usr/lib/libMesa*` or `/usr/local/lib/libMesa*` and delete them unless you have programs that need them.

```
# IF you are going to use the project GLUT distribution of GLUT, then
# unpack the Glut-3.7 packages ...
# Mesa's compile looks for it
cd /usr/src
tar -xvzf glut-3.7.tar.gz
tar -xvzf glut_data-3.7.tar.gz
# IF you are using this GLUT, use the --with-glut=/usr/src/glut-3.7
# parameter with Mesa's ./configure below in addition to the --prefix

cd /usr/src
tar -xvzf MesaLib-4.0.1.tar.gz
tar -xvzf MesaDemos-4.0.1.tar.gz
cd Mesa-4.0.1
./configure --prefix=/usr
make
make install
ldconfig
```

Important: At this point, Mesa installed its own version of the `glx.h` include files over the ones that **XFree86** installed. This will cause some programs to fail to compile and is corrected by copying the **XFree86** GL include files from the X source back to your system:

```
cp /usr/src/release/xc/include/GL/*.h /usr/X11R6/include/GL
```

3.4. Install Nvidia OpenGL drivers

3.4.1. Install NVIDIA kernel driver package

First, unpack the kernel driver source.

```
cd /usr/src
tar -xvzf NVIDIA_kernel-1.0-2314.tar.gz
tar -xvzf NVIDIA_GLX-1.0-2313.tar.gz
cd NVIDIA_kernel-1.0-2314
```

Now, before building and installing this kernel driver, it has some AGP options that can affect performance. You shouldn't really attempt to use these options during your first attempt at getting your card working and not unless you are using a very recent 2.4 kernel and the lastest nvidia drivers.

The Linux kernel source can be compiled with an AGP character device that the Nvidia driver can use to get better performance. If your kernel does not have the AGP driver for your motherboard chipset compiled in, then the Nvidia kernel driver uses its own built−in AGP support if your video card is an AGP card. If you want to experiment with the Linux kernel AGP support, you should be able to rebuild and install your kernel with the appropriate support:

```
cd /usr/src/linux
make menuconfig
# Go to Character devices and put a * by /dev/agpgart support
# and also put a * by your motherboard chipset type.
# Go to the Processor type and features and put a * by
# MTTR support.
# Save the config.
make
make modules
make install
make modules_install
reboot
```

Futher tweaking can be done to the file `os−registry.c` in the NVIDIA kernel source. Looking though this file, you will see many flag variables (they can be set to 0 or 1) to control options that affect performance and stability! You should try your configuration with this file unmodified first to see that your system works. If it does, you can try these options. Among the options you can try here are:

- Enabling AGP 4x on VIA chipsets (by default constrained to only 2x)
- Enabling Side Band Addressing (your card needs to support this)
- Enabling Fast Writes (IIRC, this must be enabled in your motherboard BIOS too)

If you experience problems starting X, see the files `TNT_USERS_README` and `M64_USERS_README`. These files explain how to tweak the kernel driver. They were written to fix problems with TNT and TNT2 M64 cards but these tweaks are reported to help the GeForce2 MX also. Try bypassing the BIOS as explained in `M64_USERS_README`.

After you have tweaked (or not tweaked) your Linux kernel and `os−registry.c` file, you can build and install the kernel module.

```
# The make command will build and install the driver:
make
```

After the driver is loaded, you can see the driver configuration with **cat /proc/nv/card0**

3.4.2. Install NVIDIA GLX package

Installing the Nvidia OpenGL library package is nothing too special. First you need to clean up some old files.

```
# delete the libGL.* files that come with XFree86 / Mesa ...
# the nvidia libGL.* should replace them
# The more recent Nvidia Makefile installer does this for you.

cd /usr/X11R6/lib
rm libGL.*
cd modules/extensions
rm libGL*
rm libglx*
```

```
        cd /usr/lib
        rm libGL.*
```

With the conflicting old files gone, you can begin the installation.

```
        cd ..
        cd NVIDIA_GLX-1.0-2313
        make
        ldconfig

        # make might not install the C header files that come with
        # the libraries in the NVIDIA_GLX package so, do this:
        cd usr/include/GL
        cp *.h /usr/include/GL
        # usr/include/GL is a subdirectory in the NVIDIA_GLX package.
        # /usr/include/GL should be a symlink to /usr/X11R6/include/GL
        # so you could copy to there instead if you want.

        # Make a basic XF86Config file using the "nv" driver:
        cd /etc/X11
        xf86config
        # Follow the prompts and fill in the information xf86config asks for.
        # Select the Nvidia GeForce or appropriate name.
        # You can test X with this XF86Config file, or continue for OpenGL:

        # You must edit XF86Config and set the following:
        vi XF86Config
        #       Load "glx"
        #       Replace 'driver "nv"' with 'driver "nvidia"'
        #       Put "1600x1200" first (or your preferred screen resolution)
        #       Copy ttf fonts from Windows into a font directory and add a font path.
    #            Use ttmkfdir (check freshmeat.net) to a fonts.dir file.
        #       A good place to keep your own fonts is /usr/local/share/fonts ...

        # Nvidia drivers do NOT use the dri module - don't load it.

        # You may like to edit /etc/X11/xinit/xinitrc to have run "startkde"
        # or "gnome-session" instead of twm.

        # Note: /usr/include/GL should be a symlink to /usr/X11R6/include/GL
```

Specifying "nvidia" for the driver in the `XF86Config` makes that take effect each time you **startx**. But the `NVdriver` kernel driver will have to be loaded before you startx. It can be loaded with:

```
                # to load it
                insmod NVdriver
                # If you need to unload it:
                rmmod NVdriver
```

You should not have to use **insmod** manually. The NVdriver installation should have inserted a line into `/etc/modules.conf` (or `conf.modules`) that looks something like:

```
                alias char-major-195 NVdriver
```

If this line is present, `NVdriver` is loaded automatically when **X** is started. You can check if its loaded using the command, **lsmod**.

In my experience, your video system will become unstable if you compile, load, and unload the NVdriver module. You should reboot your system after rebuilding this module to help make sure your system doesn't lock inside X. Its possible that your screen will go black and the keyboard will become unresponsive after switching NVdriver. It is advisable to always have another computer with telnet or ssh that you can use to get into your Linux box to shut it down properly if this happens.

3.5. Install Qt

```
        # for Qt, there is no "make install", just place the source
        # where you want it to live:
        cd /usr/local
        tar −xvzf qt−x11−2.2.4.tar.gz
        ln −s qt−2.2.4 qt
        cd qt
```

Read the `INSTALL` file about environment variables to setup before you try to build Qt. You can add the following to `/etc/profile`:

```
                QTDIR=/usr/local/qt
                PATH=$PATH:$QTDIR/bin
                MANPATH=$MANPATH:$QTDIR/man
                LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$QTDIR/lib
                export QTDIR PATH MANPATH LD_LIBRARY_PATH
```

`LD_LIBRARY_PATH` is optional if you include an entry in `/etc/ld.so.conf` for the library path: `/usr/local/qt/lib`, then run **ldconfig** to update `/etc/ld.so.cache`.

```
        # note: configure has some options you can try, to see them
        # see ./configure --help
        ./configure

        # NOTE: when you run make as suggested on the next line, you may
        # encounter a make error that halts the build IF you run make
        # from outside X.  The program $QTDIR/bin/uic (the User Interface Compiler)
        # may Segmentation Fault when run from a Linux console.  You can run
        # "startx" and use the twm (tiny window manager) and xterm (or whatever you
        # might have setup for X) to run the rest of the Qt build.  If for some
        # reason twm is not even available, then you can run "XFree86 &", use
        # "CTRL−ALT−F1" to get to a console, start an xterm as
        #  "xterm −display localhost:0.0 &", then switch back to X with "ALT−F7".

        make

    # Only for old versions of Qt before 2.1.0 or so ...
        # compile the opengl extension
        # Note that in qt 2.2.0 on, the OpenGL support has been moved out of extensions
        # and is now a standard part of the library that is installed if configure
        # finds OpenGL installed on your system.  If you were to not want OpenGL
        # support in Qt, you'd have to pass the −no−opengl option to configure.
        cd extensions/opengl/src
        # Check the Makefile and ensure there are not Mesa references.
        make


        ldconfig
```

```
        cd ../examples
        # Try compiling and running the examples.
```

3.6. Install GLUT 3.7 Distribution (optional)

If you installed the MesaDemos/MesaLib package, then you have already installed GLUT 3.7 since it is included with MesaDemos. However, you may be interested in installing the GLUT manpages and you can skip right to the "Install GLUT manual pages", below ...

Installing GLUT is a bit tricky. I'm not too familiar with **imake**, the program that it uses to manage the Makefiles, and didn't quite see how to get GLUT to install to where I wanted it (`/usr/lib`, but MesaDemos will do this without any trouble though). It can be done manually anyhow:

```
        cd /usr/src
        tar −xvzf glut−3.7.tar.gz
        cd glut−3.7

        Read the file: README.linux
        cd linux
        READ the file: README
        cp Glut.cf ..
        cd ..
        Edit Glut.cf: remove any Mesa references.
        Replace any −lMesaGL −lMesaGLU with −lGL −lGLU if needed.
        In particular, replace:
                OPENGL = $(TOP)/../lib/libMesaGL.so
                GLU = $(TOP)/../lib/libMesaGLU.so
        with:
                OPENGL = −lGL
                GLU = −lGLU

        ./mkmkfiles.imake
        cd lib/glut
        cp /usr/src/glut−3.7/linux/Makefile .
        Edit the Makefile: remove any Mesa references.
        Replace any −lMesaGL −lMesaGLU with −lGL −lGLU if needed.
        In particular, replace:
                OPENGL = $(TOP)/../lib/libMesaGL.so
                GLU = $(TOP)/../lib/libMesaGLU.so
        with:
                OPENGL = −lGL
                GLU = −lGLU

        make
        ln −s libglut.so.3.7 libglut.so
        ln −s libglut.so.3.7 libglut.so.3
        cp −d libglut.* /usr/lib
        cd ..
        cd gle
        # make a shared lib for libgle
        make
        gcc −shared −o libgle.so.3.7 *.o
        ln −s libgle.so.3.7 libgle.so
        ln −s libgle.so.3.7 libgle.so.3
        cp −d libgle.* /usr/lib
        cd ..
```

```
cd mui
# make a shared lib for libmui
make
gcc −shared −o libmui.so.3.7 *.o
ln −s libmui.so.3.7 libmui.so
ln −s libmui.so.3.7 libmui.so.3
cp −d libmui.* /usr/lib

# Install the GLUT manual pages (not included with MesaDemos)
cd /usr/src/glut−3.7
make SUBDIRS=man Makefile
cd man/glut
make install.man
ldconfig

cd ../../progs/demos/ideas
# edit the Makefile, change OPENGL = −lGL and GLU = −lGLU
make
./ideas
# test compiling some demos
# take a look at which libraries have to be linked (−lX11 ...) in
# the Makefiles.  Qt's tmake program available at www.troll.no
# is a quick way to make a Makefile but you have to edit it
# and add the −l needed.
```

3.7. Install Java 3D (optional)

If you already have a Java Software Development Kit (JSDK) or Java Runtime Environment (JRE) installed, then you can skip parts of this section. If you are using a JRE only, you'll have to get the JRE version of the Java 3D package and adapt these instructions.

It is recommended that you have the lastest version of Netscape, which at this time of writing is 6.2.1, if you plan to install the Java PlugIn for **netscape**. It works, but you may (or may not) experience Segmentation Faults when leaving a page that contained a Java 3D applet. KDE Konqueror can also be used to view Java 3D applets.

If you have not installed the Java SDK yet, you should have downloaded it already at least. Installing the JSDK is simple. You should follow the instructions that comes with it or follow my example below, based on using the Sun download.

```
# The Sun download is a type of binary shell archive (man shar).
# Make it executable and run it to unpack its contents
chmod 744 j2sdk−1_3_1_02−linux−i386.bin
./j2sdk−1_3_1_02−linux−i386.bin
mv jdk1.3.1_02 /usr/local
cd /usr/local
ln −s jdk1.3.1_02 jdk
```

Next is to unpack Java 3D and finish setting up the environment for the Java SDK.

```
cd jdk
tar −xvyf ~/java3d−1.2.1_01−fcs−linux−i386−sdk.tar.bz2
cd jre/lib/ext
```

```
        cp j3d* ..
        cp vecmath.jar ..
        cd /usr/local
        chown −R root:root jdk1.3.1_02
```

Edit `/etc/profile` or, as on many systems, you can add a new file like `java.sh` to the directory `/etc/profile.d/`. To either file, add:

```
                        JAVA_HOME=/usr/local/jdk
                        PATH=$PATH:$JAVA_HOME/bin
                        MANPATH=$MANPATH:$JAVA_HOME/man
                        export JAVA_HOME PATH MANPATH
```

If you used a separate file `java.sh`, remember to make it executable. Start a new login terminal for these changes to take affect.

This completes the installation of the Java 2 SDK, which includes the JRE and the Java 3D extension.

You can install the Java PlugIn for **netscape**:

```
        # go to where netscape is installed
        cd $MOZILLA_HOME
        cd plugins
        ln −s /usr/local/jdk/jre/plugin/i386/ns600/libjavaplugin_oji.so libjavaplugin_oji.so
        # This installs it globally for all users
        # Each user can run ControlPanel to customize the Java Plugin preferences.
        ControlPanel
        # Then try it out:
        netscape &
```

When netscape loads, go to Edit+Preferences−>Advanced and Enable Java and Enable Java Plugin, then exit Netscape.

Test Java 3D demos:

```
                cd $JAVA_HOME/demo/java3d/GearTest
                java GearBox &
                # runs as normal java application
                netscape GearBox_plugin.html &
                # runs in netscape as an applet
```

If you experience trouble with Java, you can try deleting `~/.java` and related files in your home directory, then try again. These files left over from a prior Java installation can cause problems.

If all works well, you should have a complete Java Developement and Runtime Environment for both normal apps and high−performance 3D apps. See http://java.sun.com/ for further information about Java and the Java 3D extension.

Chapter 4. Final Comments

I believe that is about it! At this point you should have a fully functioning OpenGL system for running and developing OpenGL apps.

You can try building the demos in `/usr/src/Mesa-4.0.1/{demos,xdemos}` by using the `Makefile.X11` as `Makefile` and running "**make targets**" or "**make teapot**" etc. They should build and link with the hardware accelerated libGL and run very fast! Qt has a OpenGL example in `$QTDIR/examples/gear`, that you should be able to run as simply as "**make;./gear**".

Just about any standard GL/GLX/GLU/glut app should run fine, such as WolfGL, GLQuake, **glqwcl.glx** (GLQuakeWorld), **quake2**, and of course ... **quake3**!!!

HAVE FUN!

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Version 1.1, March 2000

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