Asus Eee PC & Linux for Robotics purposes with Java

Versión 0.1

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Index

Revision History

Name	Date	Reason For Changes	Version
Juan Antonio Breña Moral	14/06/2008		0.1

1.- Introduction

1.1.- Goals

This document has been written to explain how to develop software with Java in a Linux Distribution like Ubuntu. The hardware used to develop the software is an Asus EEE PC Serie 701.

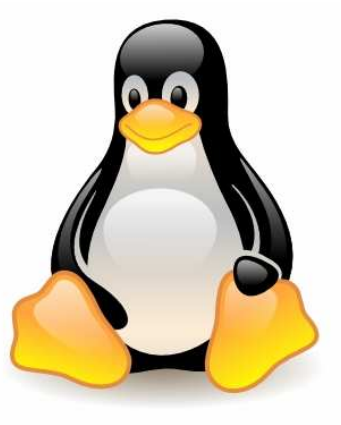
The ASUS Eee PC is a subnotebook computer designed by ASUS which it has a light weight, it can be managed by a Linux-based operating system, it uses a solid-state drive and it has a relatively low cost.

Enjoy, Learn, Contact with me to improve this document and share your ideas.

Juan Antonio Breña Moral.
www.juanantonio.info

1.2.- Linux

Linux is the name usually given to any Unix-like computer operating system that uses the Linux kernel. Linux is one of the most prominent examples of free software and open source development: typically all underlying source code can be freely modified, used, and redistributed by anyone.



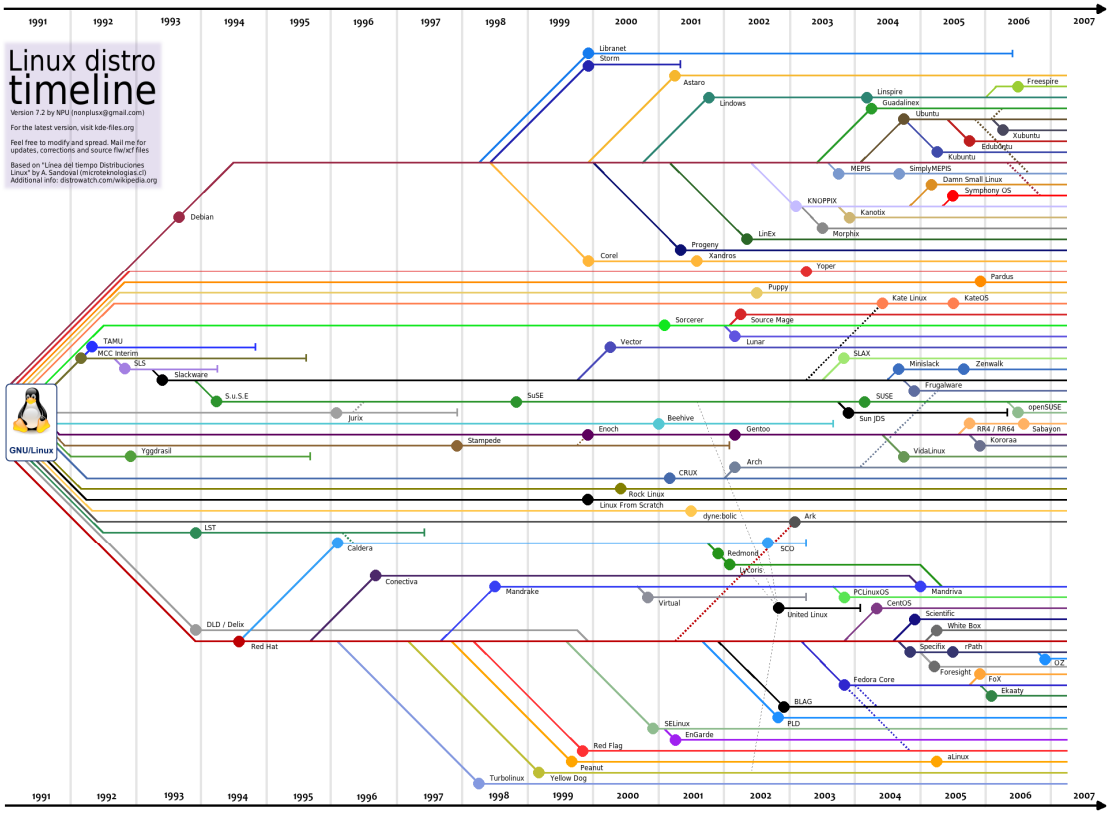
The name "Linux" comes from the Linux kernel started in 1991 by Linus Torvalds. The system's utilities and libraries usually come from the GNU operating system, announced in 1983 by Richard Stallman. The GNU contribution is the basis for the alternative name GNU/Linux.

Predominantly known for its use in servers, Linux is supported by corporations such as Dell, Hewlett-Packard, IBM, Novell, Oracle Corporation, Red Hat, and Sun Microsystems. It is used as an operating system for a wide variety of computer hardware, including desktop computers, supercomputers and embedded devices such as E-book readers, video game systems (PlayStation 2, PlayStation 3 and XBox), mobile phones and routers.

1.2.1.- Ubuntu

Ubuntu is an entirely open source operating system built around the Linux kernel.

Ubuntu is a operating system based on Debian, one of the most widely acclaimed, technologically advanced, and well-supported distributions, Ubuntu aims to create a distribution that provides an up-to-date and coherent Linux system for desktop and server computing. Ubuntu includes a number of carefully selected packages from the Debian distribution and retains its powerful package management system which allows easy installation and clean removal of programs.



1.3.- Java

Java is a programming language originally developed by Sun Microsystems and released in 1995 as a core component of Sun Microsystems' Java platform. The language derives much of its syntax from C and C++ but has a simpler object model and fewer low-level facilities. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of computer architecture.

The original and reference implementation Java compilers, virtual machines, and class libraries were developed by Sun from 1995. As of May 2007, in a compliance with the specifications of the Java Community Process, Sun made available most of their Java technologies as free software under the GNU General Public License. Others have also developed alternative implementations of these Sun technologies, such as the GNU Compiler for Java and GNU Classpath.

1.4.- LeJOS Project

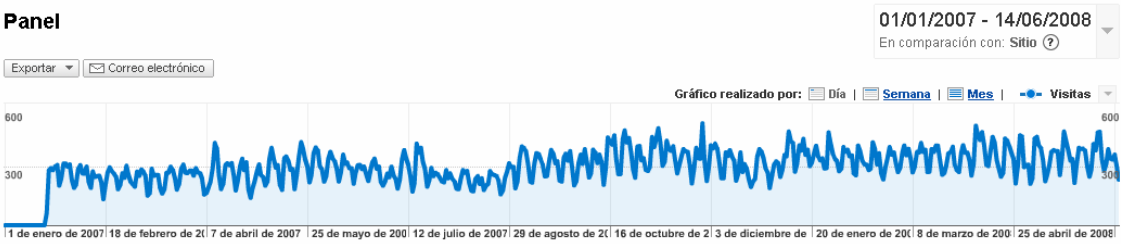
LeJOS is Sourceforge project created to develop a technological infrastructure to develop software into Lego Mindstorm Products using Java technology.

Currently leJOS has opened the following research lines:

1. NXT Technology
    a. NXJ

b. iCommand
2. RCX Technology
   a. leJOS for RCX

LeJOS project's audience has increased. Currently more than 500 people visit the website every day.



This eBook will focus in NXT technology with NXJ using a Windows Environment to develop software.

1.5.- NXT Brick

The NXT is the brain of a MINDSTORMS robot. It's an intelligent, computer-controlled LEGO brick that lets a MINDSTORMS robot come alive and perform different operations.

Motor ports
The NXT has three output ports for attaching motors - Ports A, B and C

Sensor ports
The NXT has four input ports for attaching sensors - Ports 1, 2, 3 and 4.

USB port
Connect a USB cable to the USB port and download programs from your computer to the NXT (or upload data from the robot to your computer). You can also use the wireless Bluetooth connection for uploading and downloading.

Loudspeaker
Make a program with real sounds and listen to them when you run the program

NXT Buttons
Orange button: On/Enter /Run
Light grey arrows: Used for moving left and right in the NXT menu
Dark grey button: Clear/Go back

NXT Display
Your NXT comes with many display features - see the MINDSTORMS NXT Users Guide that comes with your NXT kit for specific information on display icons and options

Technical specifications

- 32-bit ARM7 microcontroller
- 256 Kbytes FLASH, 64 Kbytes RAM
- 8-bit AVR microcontroller
- 4 Kbytes FLASH, 512 Byte RAM
- Bluetooth wireless communication (Bluetooth Class II V2.0 compliant)
- USB full speed port
- 4 input ports, 6-wire cable digital platform (One port includes a IEC 61158 Type 4/EN 50 170 compliant expansion port for future use)
- 3 output ports, 6-wire cable digital platform
- 100 x 64 pixel LCD graphical display
- Loudspeaker - 8 kHz sound quality. Sound channel with 8-bit resolution and 2-16 KHz sample rate.
- Power source: 6 AA batteries

1.5.1.- NXT Sensors used in the eBook

NXT Sensors used in the document are the following:

- NXT Motor
- Ultrasonic Sensor
- Compass Sensor
- NXTCam
- Tilt Sensor
- NXTCam
- RFID Sensor

NXT Motor

Ultrasonic Sensor

Compass Sensor

Tilt Sensor

NXTCam

Lattebox NXTe

1.6.- About the author

Juan Antonio Breña Moral collaborates in leJOS Research team since 2006. He works in Europe leading Marketing, Engineering and IT projects for middle and large customers in several markets as Defence, Telecommunications, Pharmaceutics, Energy, Automobile, Construction, Insurance and Internet.

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2.- Install Ubuntu on Asus Eee pc

2.1.- Introduction

Ubuntu can be installed on Asus Eee PC by 3 ways:

1. CD-ROM
2. USB
3. Network

In this document, I will explain ubuntu's installation using CD-ROM

2.2.- Ubuntu Installation

2.2.1.- Ubuntu Installation with a CD-ROM

If you want to install in your Asus Eee PC a ubuntu Distro, it is necessary to download latest ubuntu's release, from:

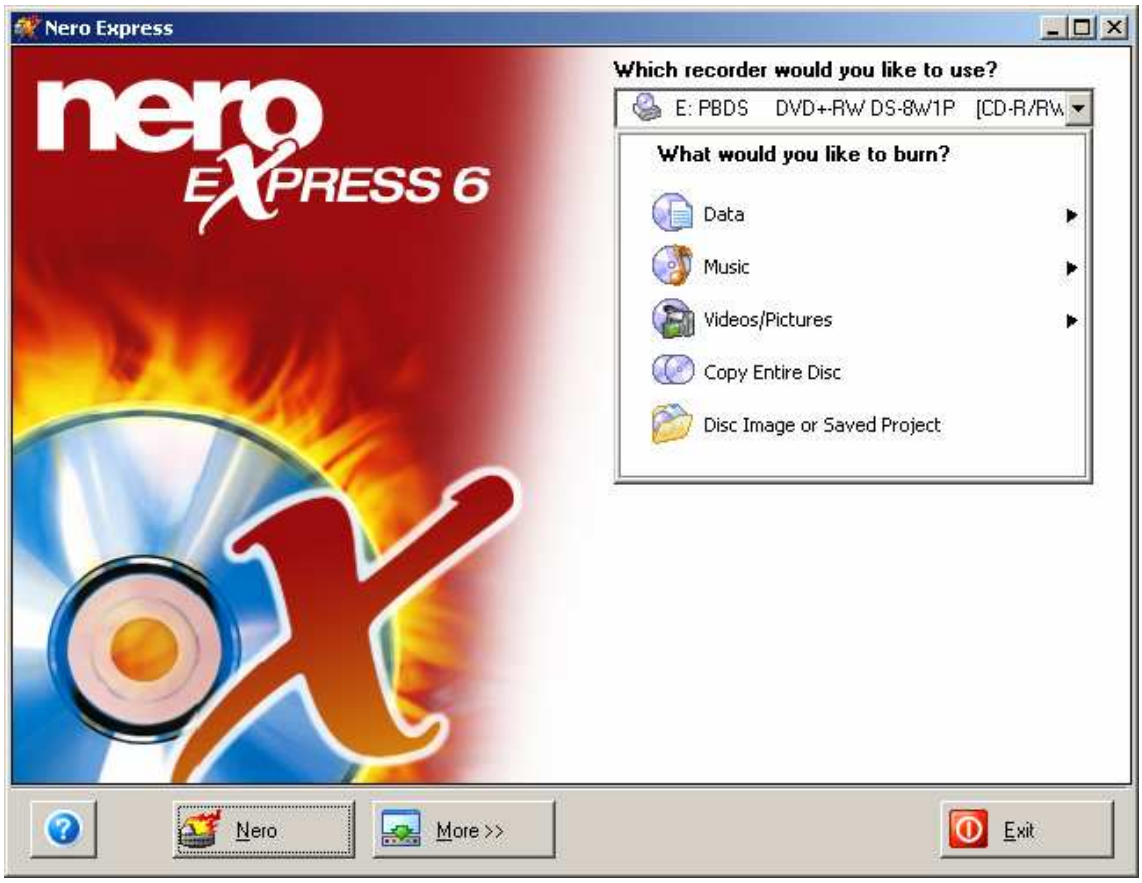
http://www.ubuntu.com/GetUbuntu/download

Once you have stored the file ubuntu-8.04-desktop-i386.iso on your windows computer then the next step is create a bootable CD. To achieve this step, it is necessary to use a commercial or not commercial software to create a bootable CD.

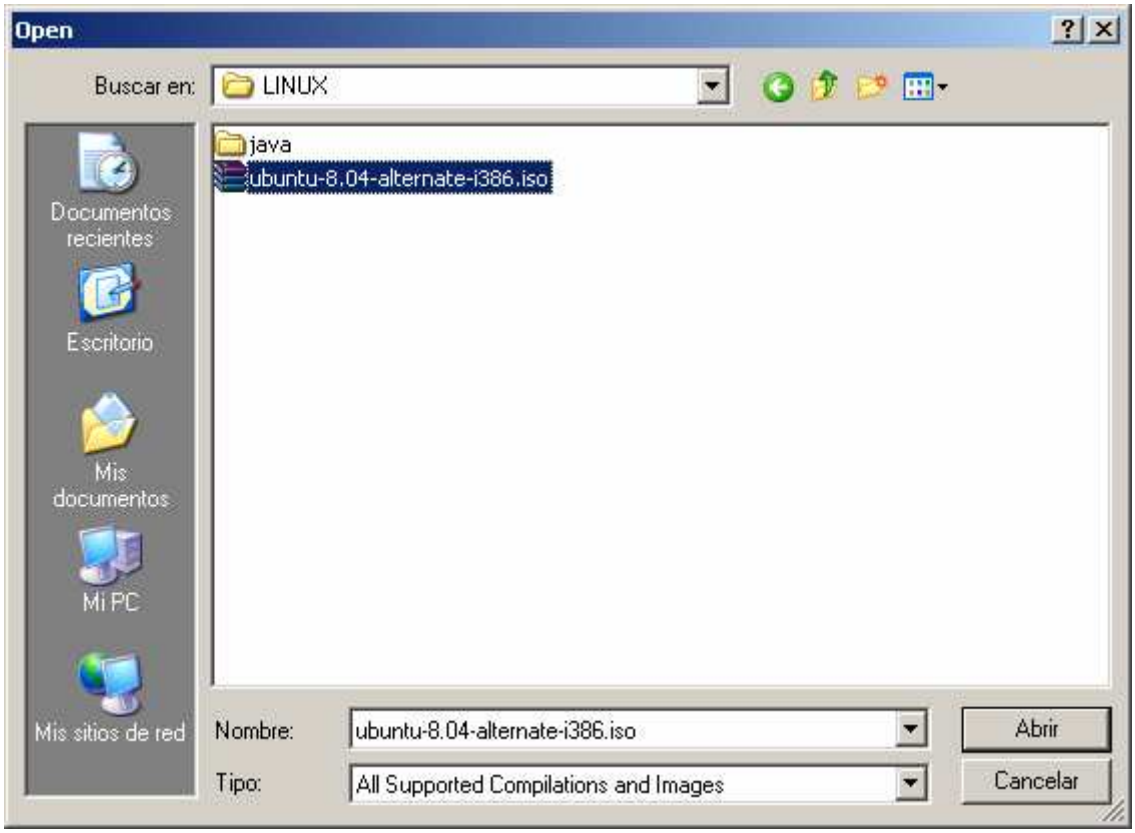
I have choosen Nero Software.

2.2.1.1.- Create a bootable CD-ROM with Nero

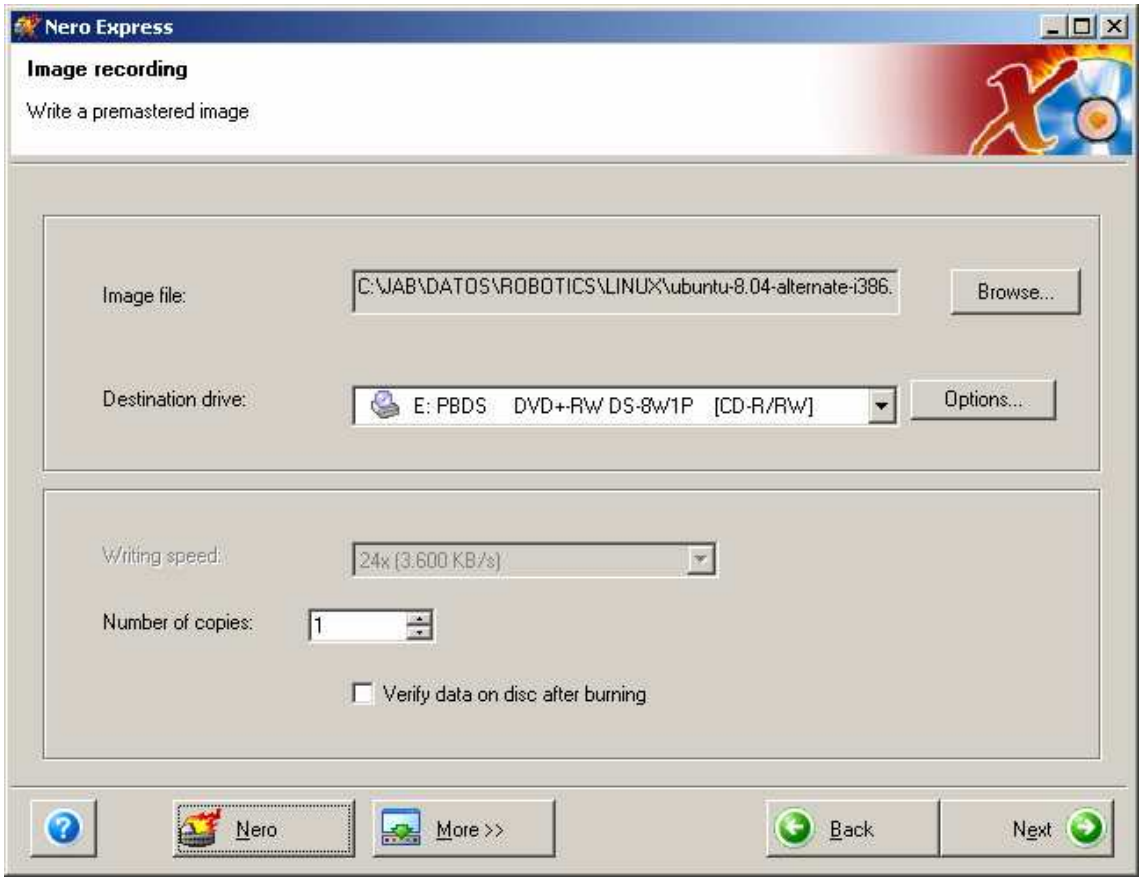
Launch a Nero express edition and select the option Disk Image from the main menu:



And select the ubuntu iso file:



And click in next button:



Once you have burnt your bootable CD-ROM then you will modify BIOS on Asus Eee PC to indicate what device will have used in the boot process. Turn on Eee PC and click in F2 to enter in BIOS.

BIOS has 5 options:

- Main
- Advanced
- Security
- Boot
- Exit

Enter in Boot tab and select the option Boot Device Priority. In this section update the option 1st Boot Device with the value ATAPI CD-ROM then go to Exit tab and click in Exit & Save Changes, then when your Eee PC reboot again, it will boot the computer using CD-ROM and you will see the following image:

Use ubuntu's installer to finish the process.

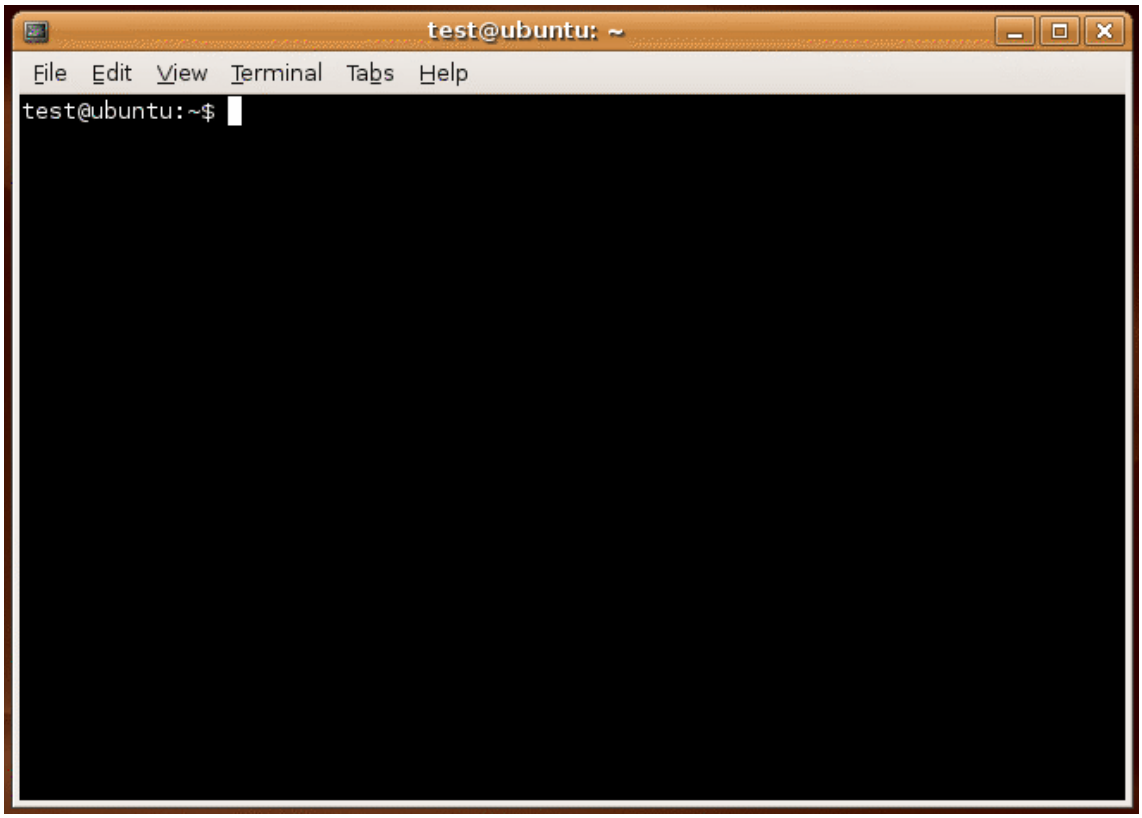
2.3.- Ubuntu Tools: SSH Server, Putty & SCP

Once you have installed Ubuntu on your Eee PC, it is necessary to make several actions to integrate perfectly Ubuntu with the hardware. If you normally use Windows at home or at work, there are some useful tools to work with a Linux remotely from Windows:

1. Putty
2. WinSCP

These tools use the protocol SSH, Secure Shell to communicate data from Windows to Linux.

When you installed Ubuntu, you didn't install SSH support, then you need install it. The easiest way to install software on ubuntu is using console. Connect an ethernet wire on your Eee PC with Ubuntu to access to Internet and open a terminal. To open a terminal, click in applications >> Accessories >> Terminal



Once you have launched a terminal, then you have to enter as root user:

```
sudo –s
```

Enter your password. Once you use a root user, then you will enter the following commands

```
apt-get update
apt-get upgrade
apt-get install openssh-server
```

Once your ubuntu has ssh supports, downloads on your Windows the tools: Putty and WinSCP to operate with Ubuntu.

2.3.1.- Putty

PuTTY is a free implementation of Telnet and SSH for Win32 and Unix platforms, along with an xterm terminal emulator. PuTTY which it manages SSH, Telnet and Rlogin network protocols.

These protocols are all used to run a remote session on a computer, over a network. PuTTY implements the client end of that session: the end at which the session is displayed, rather than the end at which it runs.

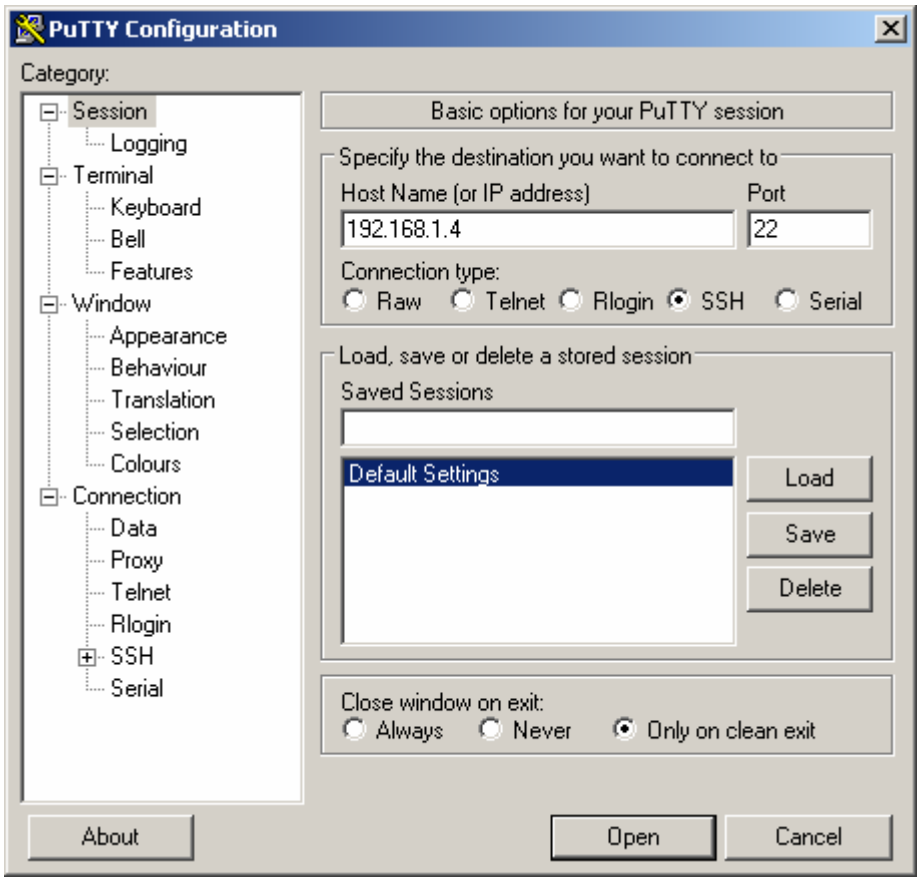
Download a latest release from:
http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html

Make an inquiere to know what IP has. Use the command ifconfig

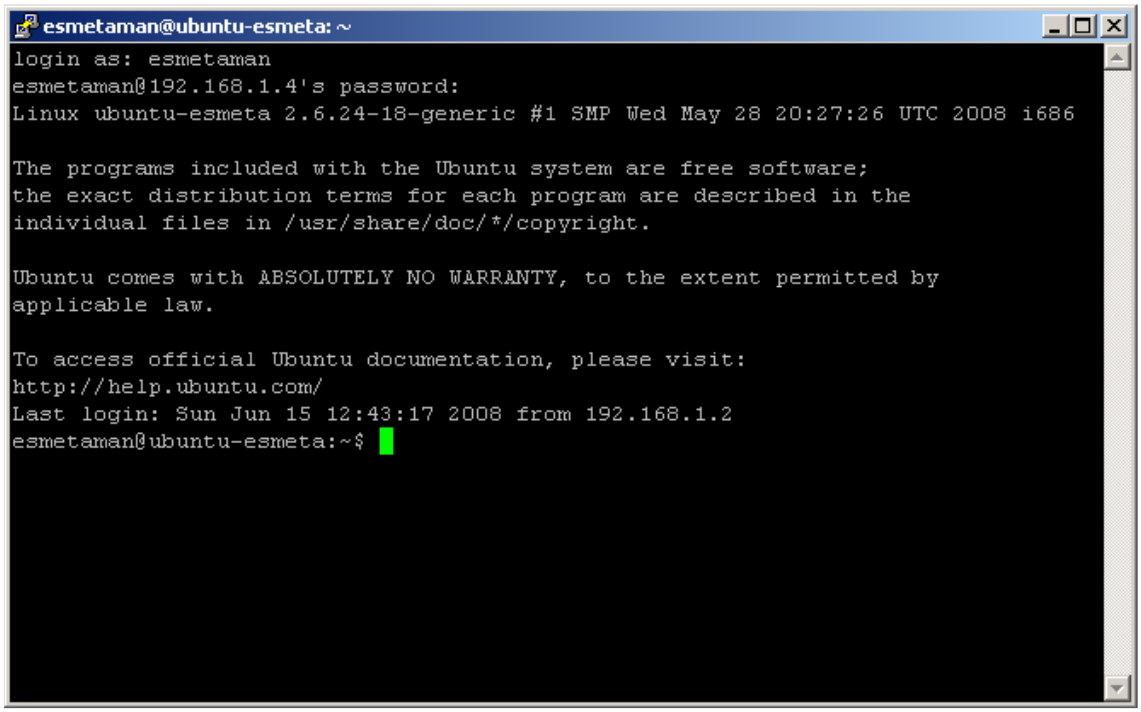
```
ifconfig
```

```
esmetaman@ubuntu-esmeta:~$ ifconfig
eth0      Link encap:Ethernet  direcciÃ³nHW 00:1e:8c:d3:e0:cd
          inet direcciÃ³n:192.168.1.4  DifusiÃ³n:192.168.1.255
MÃ¡scara:255.255.255.0
          direcciÃ³n inet6: fe80::21e:8cff:fed3:e0cd/64
Alcance:VÃ-nculo
          ARRIBA DIFUSIÃN CORRIENDO MULTICAST  MTU:1500  MÃ©trica:1
          RX packets:360 errors:0 dropped:0 overruns:0 frame:0
          TX packets:378 errors:0 dropped:0 overruns:0 carrier:1
          colisiones:0 txqueuelen:1000
          RX bytes:41980 (40.9 KB)  TX bytes:0 (0.0 B)
          Memoria:fbfc0000-fc000000
```

Now, you know the IP that your Ubuntu use in your LAN. Execute Putty on windows and edit the textbox Host Name (or IP address) with the value: 192.168.1.4



Then click in Open button to connect:



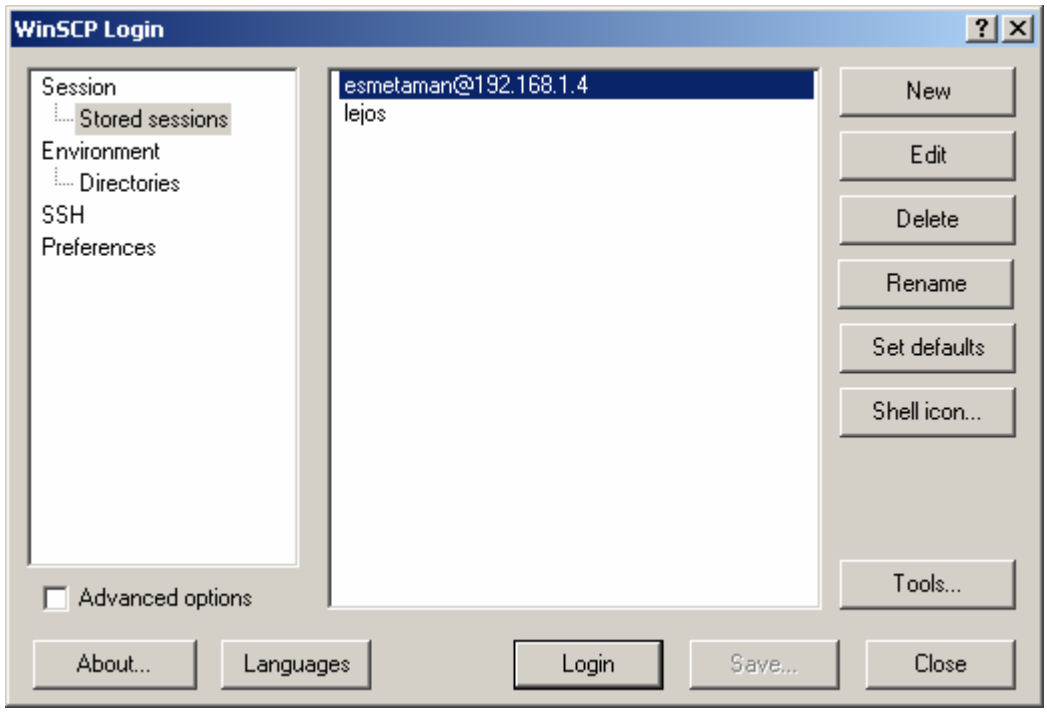
With Putty, you have a useful tool to manage your Ubuntu remotely using your Windows System.

2.3.2.- WinSCP

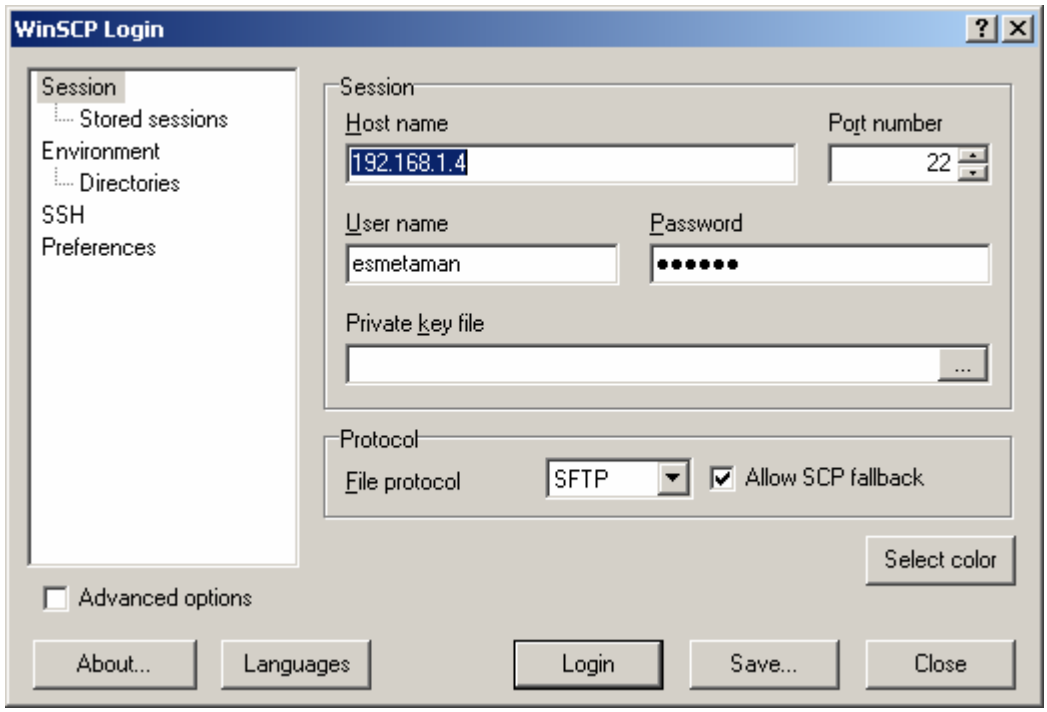
WinSCP is an open source SFTP client and FTP client for Windows. Its main function is the secure file transfer between a local and a remote computer. Beyond this, WinSCP offers basic file manager functionality. It uses Secure Shell (SSH) and supports, in addition to Secure FTP, also legacy SCP protocol.

Download WinSCP using this URL:
http://winscp.net/eng/download.php

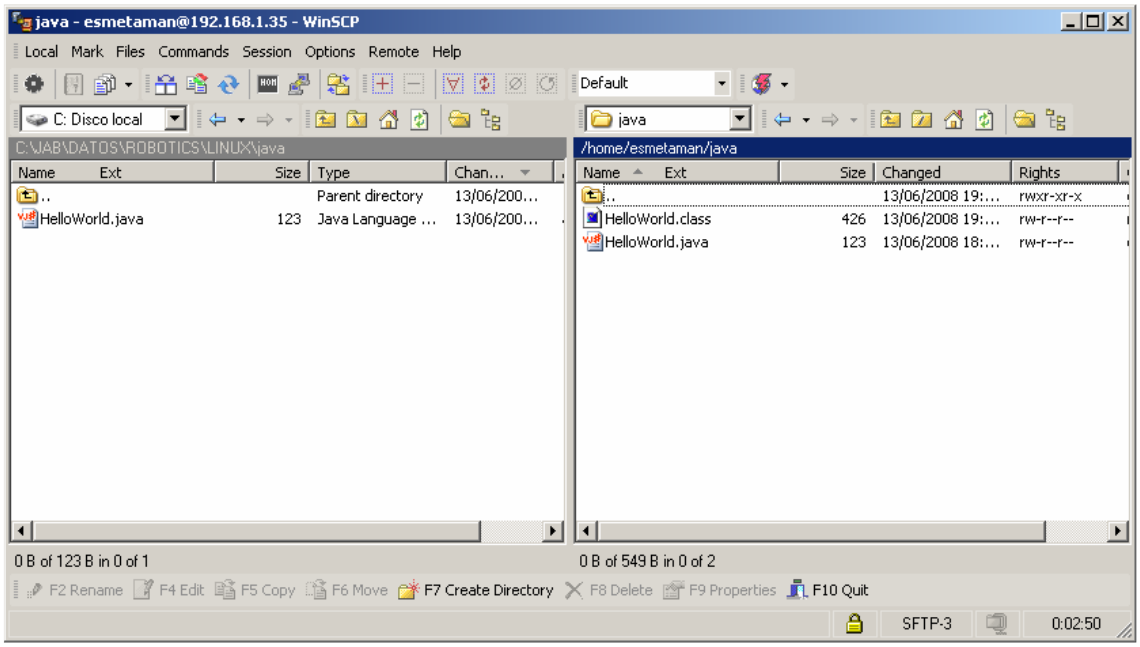
Once you have installed WinSCP, launch it:



Create an account:



And save it then click in login button. This tool will be very useful to transfer Java programs stored in a Windows machine.



2.4.- Ubuntu tuning for Asus Eee PC

In this point of the document, you are able to manage Ubuntu from any windows computer using Putty. Ubuntu install correctly on Asus Eee Pc, but it is neccesary to configurate somethings to use all features.

2.4.1.- Wifi

Asus Eee PC has Wifi. To enable this feature you need to execute the following commands:

```
sudo apt-get install build-essential
```

```
wget 'http://snapshots.madwifi.org/special/madwifi-nr-r3366+ar5007.tar.gz'
tar zxvf madwifi-nr-r3366+ar5007.tar.gz
cd madwifi-nr-r3366+ar5007
make clean
make
sudo make install
sudo reboot
```

Then if you will see it:

Now, your Eee PC has support for WIFI.

To manage Wireless interface, it is necessary to use the command iwconfig:

```
iwconfig

ath0      IEEE 802.11g  ESSID:""  Nickname:""
          Mode:Managed    Frequency:2.437  GHz    Access  Point:  Not-
Associated
          Bit Rate:0 kb/s   Tx-Power:17 dBm   Sensitivity=1/1
          Retry:off   RTS thr:off   Fragment thr:off
          Encryption key:off
          Power Management:off
          Link  Quality=0/70   Signal  level=-100  dBm   Noise  level=-100
dBm
          Rx invalid nwid:3262  Rx invalid crypt:0  Rx invalid frag:0
          Tx excessive retries:0  Invalid misc:0   Missed beacon:0
```

To discover all wireless networks use the following command:

```
iwlist ath0 scan

ath0      Scan completed :
          Cell 01 - Address: 00:17:9A:11:DB:24
                    ESSID:"ESMETA_WIRELESS"
                    Mode:Master
                    Frequency:2.437 GHz (Channel 6)
                    Quality=55/70  Signal level=-40 dBm  Noise level=-95 dBm
                    Encryption key:off
                    Bit Rates:1 Mb/s; 2 Mb/s; 5.5 Mb/s; 11 Mb/s; 22 Mb/s
                              6 Mb/s; 9 Mb/s; 12 Mb/s; 18 Mb/s; 24 Mb/s
                              36 Mb/s; 48 Mb/s; 54 Mb/s
                    Extra:bcn_int=200
```

If you notice, the Wifi network ESMETA_WIRELESS doesn't have any encryption. If you like to connect to this network:

```
sudo ifconfig ath0 up
sudo iwconfig ath0 essid ESMETA_WIRELESS
sudo dhclient ath0
```

If you need to connect to a Wifi Network with encription:

```
sudo ifconfig ath0 up
sudo iwconfig ath0 essid WIFI_NETWORK_WITH_ENCRYPTION
sudo iwconfig eth1 key s:PASSWORD
sudo dhclient ath0
```

Note:
Another alternative to solve Eee PC problems is using the project:

http://code.google.com/p/eee-ubuntu-support/

To use this project:

```
wget http://eee-ubuntu-support.googlecode.com/files/eee-ubuntu-
support_v0.7.tgz
tar zxvf eee-ubuntu-support_v0.7.tgz
cd eee-ubuntu-support_v0.7
sudo ./install.sh modules wifi
```

2.4.2.- Turn off correctly

To turn off correctly the eee pc it is necessary to update the file /etc/init.d/halt

```
sudo vim /etc/init.d/halt
```

to add the following line:

```
rmmod snd-hda-intel
```

2.4.3.- CPU

To improve how Ubuntu uses Eee PC use, execute:

```
sudo apt-get remove powernowd
sudo apt-get install cpufrequtils sysfsutils
sudo modprobe p4_clockmod
```

Besides it is necessary to update the file: /etc/sysfs.conf adding the following line:

```
devices/system/cpu/cpu0/cpufreq/scaling_governor = ondemand
```

Finally, edit the file /etc/modules

```
sudo vim /etc/modules
```

and add the following files :

```
p4_clockmod
cpufreq_ondemand
```

To take effect the changes, reboot

```
sudo reboot
```

2.4.4.- Sound

To enable sound support, update the file */etc/modprobe.d/snd-hda-intel*

```
sudo vim /etc/modprobe.d/snd-hda-intel
```

And add the following

```
options snd-hda-intel model=3stack-dig
```

2.4.5.- Webcam

To enable Webcam:

```
sudo aptitude install subversion
svn co svn://svn.berlios.de/linux-uvc/linux-uvc/trunk linux-uvc
cd linux-uvc
sudo make
sudo make install
sudo modprobe -r uvcvideo
sudo mv /lib/modules/$(uname -r)/ubuntu/media/usbvideo/uvcvideo.ko
/lib/modules/$(uname -r)/ubuntu/media/usbvideo/uvcvideo.ko.original
sudo cp uvcvideo.ko /lib/modules/$(uname -
r)/ubuntu/media/usbvideo/uvcvideo.ko
sudo modprobe uvcvideo
```

2.4.6.- ACPI

```
sudo apt-get install module-assistant eeepc-acpi-source
sudo m-a a-i eeepc-acpi
sudo sh -c 'echo eeepc-acpi >> /etc/modules'
```

2.4.7.- Preload

To improve preload process, execute:

```
sudo apt-get install preload
```

Update the file /etc/init.d/rc to search: CONCURRENCY=none and change the value to: CONCURRENCY=shell

```
sudo vim /etc/init.d/rc
```

2.4.8.- Swapp HDD

To protect your HDD for swapping process, edit the file `/etc/sysctl.conf`

```
sudo vim /etc/sysctl.conf
```

and add at the end of the file the following line:

```
vm.swappiness=0
```

2.5.- Ubuntu Essentials

Once you have achieved this point your Asus Eee PC has a Ubuntu distribution with all features enabled, but it is necessary to install some applications:

1. Programming
    a. Eclipse IDE
2. Utils
3. Virtualization
    a. VMWARE Server
4. System
    a. Wine
    b. Free NX
5. Internet
    a. Thunderbird

2.5.1.- Programming

2.5.1.1.- Eclipse IDE

To install Eclipse:

```
sudo apt-get install eclipse
```

2.5.2.- Utils

The following utils are very useful for ubuntu:

```
sudo apt-get install compizconfig-settings-manager gnome-art usplash
startupmanager
sudo apt-get install unace rar unrar zip unzip p7zip-full p7zip-rar
sharutils aish uudeview mpack lha arj cabextract file-roller
```

2.5.3.- Virtualization

2.5.3.1.- VMWARE Server

If you want to install VMWARE Server

```
apt-get install build-essential linux-headers-2.6.22-14-generic
sudo apt-get install xinetd
```

Pending

Read the following post:

http://daviddelprado.blogspot.com/2008/05/vmware-en-ubuntu-804.html

2.5.4.- System

2.5.4.1.- Wine

To install Wine:

```
sudo apt-get install wine
```

2.5.5.- Internet

2.5.5.1.- Thunderbird

To install Thunderbird

```
apt-get install  mozilla-thunderbird
```

sudo no-ip –C
sudo apt-get install no-ip

2.6.- Useful commands

2.6.1.- Memory

To know the memory that you have on your system:

```
df –h
top
```

2.6.2.- Permisisions

To give permissions to files and folders:

```
chmod 777 bin --recursive
```

2.6.3.- Remove applications

To remove applications:

```
apt-get --purge remove gimp
apt-get --purge remove evolution
```

2.6.4.- Clean system

To clean Ubuntu system:

```
apt-get install deborphan
deborphan
dpkg -l $(deborphan)
sudo dpkg --purge $(deborphan)
dpkg -l $(deborphan --find-config)
sudo dpkg --purge $(deborphan --find-config)
```

3.- Install Java

3.1.- Java Installation

To install Java on Ubuntu, execute the following command:

```
apt-cache search jdk
apt-get install sun-java6-jdk
ln -s /usr/lib/jvm/java-6-sun /usr/lib/jdk
```

To know what version has you installed on Ubuntu:

```
sudo update-java-alternatives -l
java -version
```

3.2.- Testing HelloWorld.java

Once your Ubuntu system has latest JVM and you can compile and execute java programs then it is time to test Java.

Create a file on your file systems:

```
vim HelloWorld.java
```

and copy and paste the following code:

```
public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello World!");
    }
}
```

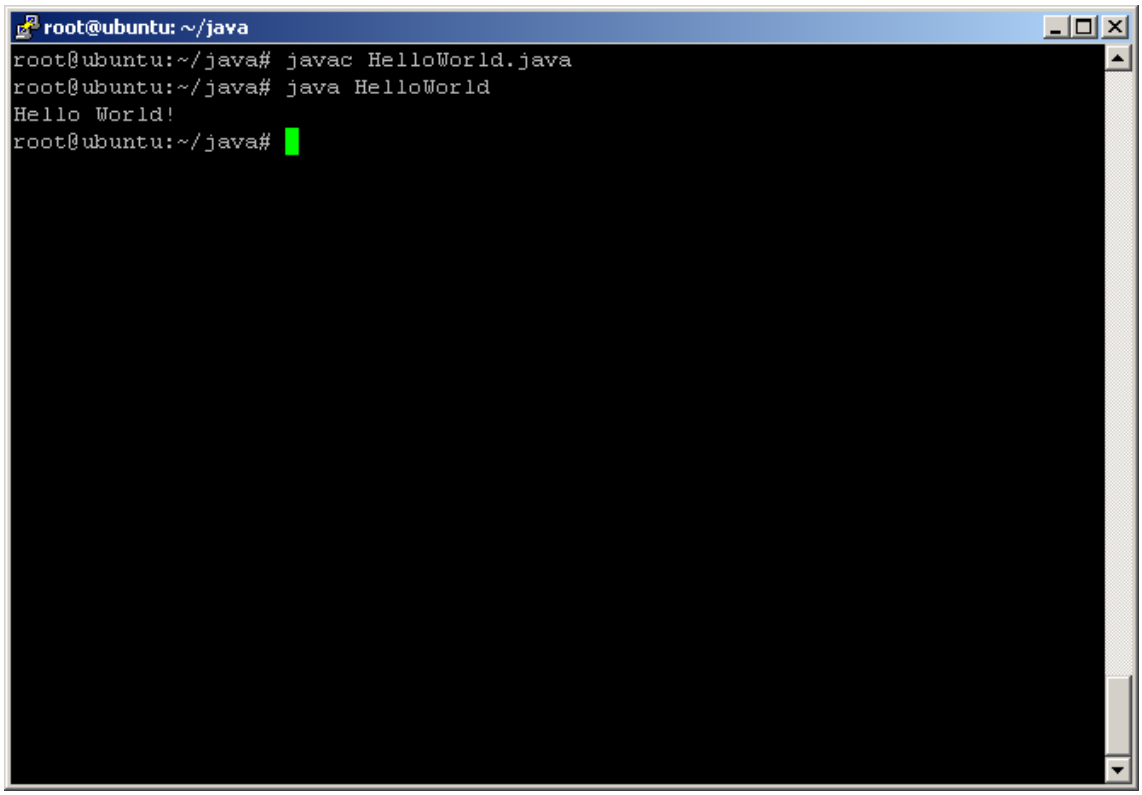
And save the file, then compile the example with the command javac:

```
javac HelloWorld.java
```

And test it:

```
java HelloWorld.
```

Now you can develop Java Software on a Eee PC with Ubuntu



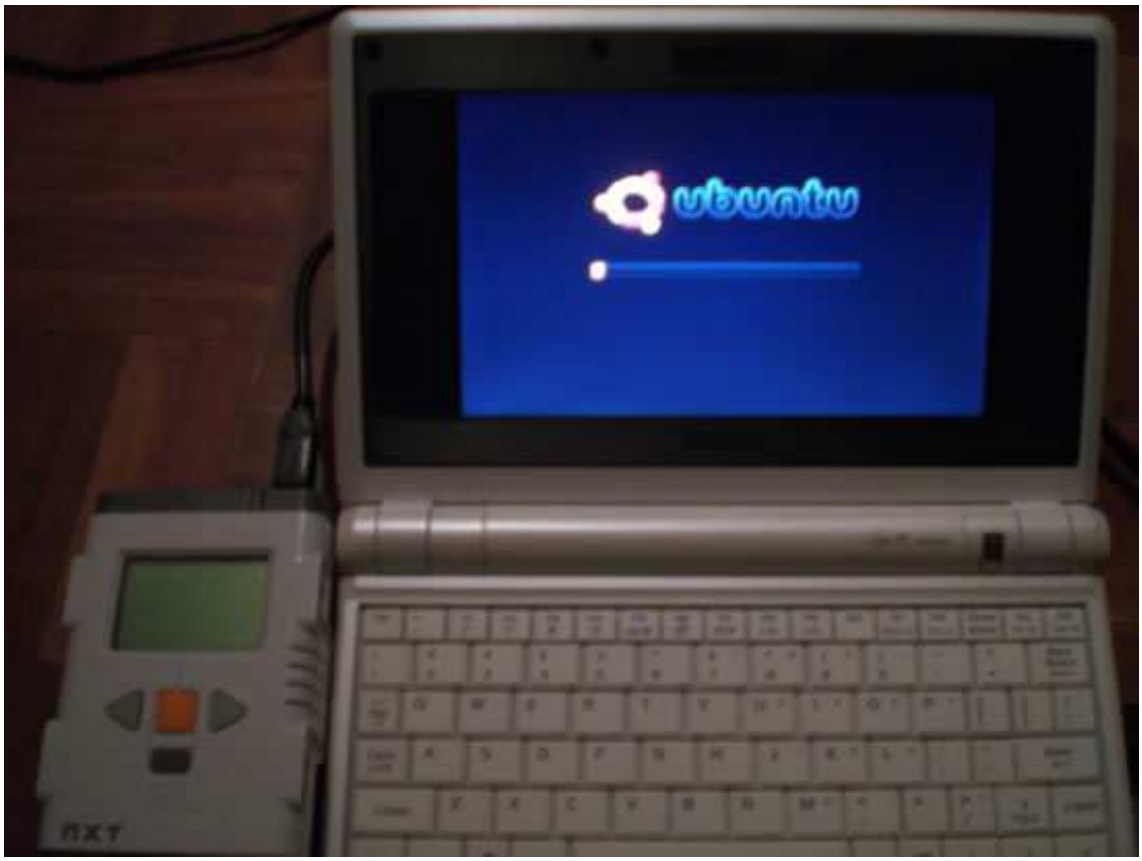
4.- LeJOS and Asus Eee PC with Ubuntu

4.1.- Introduction

Project leJOS offer the posibility to develop robotics software using Java as programming languaje. LeJOS project has 3 ways to develop with NXT Brick:

- NXJ
- PC Package
- iCommand

In this article I will explain how to use leJOS PC API and NXJ.



4.2.- Configure Ubuntu to develop leJOS robots

If you like Ubuntu as Operating System to develop robots with leJOS then the steps are:

1. Download from http://www.lejos.org latest leJOS release for NXT brick
2. Add the environment variable NXJ_HOME and set it to the directory you installed leJOS.
3. Add the leJOS bin directory to your PATH. Depending on the privilege settings, you might need to adjust the execution permissions in the bin folder.
4. Your PATH must also contain the ant binary (ant 1.6 or above).
5. You need libusb installed so the leJOS tools can access your USB port. This can be downloaded from: http://libusb.sourceforge.net/
6. Now you need to build the distribution. Switch to the build folder and run ant. Note that depending on the privilege settings you might need to adjust the execution permissions in the release folder.

I am going to explain all steps:

4.2.1.- Download and configure leJOS release

Download from lejos.org latest release:

Download latest release:

```
Wget http://kent.dl.sourceforge.net/sourceforge/lejos/lejos_NXJ_0_6_0beta.tar.gz
tar zxvf lejos_NXJ_0_6_0beta.tar.gz
```

Move lejos_nxj to the folder where you store your robotics projects:

```
mv ./lejos_nxj /media/disk/robotics/nxj/
```

4.2.2.- Create environment variables.

Configure environment variables on ubuntu. When you init Ubuntu, $PATH contain the following values:

```
export
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr
/games:
```

Discover where you have installed Java JDK: /usr/lib/jvm/java-6-sun

```
export JAVA_HOME=/usr/lib/jvm/java-6-sun
export CLASSPATH=/usr/lib/jvm/java-6-sun/lib
export PATH=$PATH:/usr/lib/jvm/java-6-sun/bin

export NXJ_HOME=/media/disk/robotics/nxj/lejos_nxj
export PATH=$PATH:$NXJ_HOME/bin/
chmod 777 /media/disk/robotics/nxj/lejos_nxj/bin --recursive

#ANT_HOME=/usr/bin/
#export PATH=$PATH:$ANT_HOME
```

This environment variables should be stored in the following files:

```
vim .bash_profile
vim .bashrc
```

for a unique user or edit the file /etc/profile to store environment variables for all users.

```
vim /etc/profile
```

After updating the files, log out to take effect the changes.

4.2.3.- LibUSB.

Download libusb and install:

```
wget http://dfn.dl.sourceforge.net/sourceforge/libusb/libusb-
0.1.12.tar.gz
tar zxvf libusb-0.1.12.tar.gz
cd libusb-0.1.12
./configure
make
make install
```

Another alternative:

```
sudo aptitude install libusb-0.1-4 libusb-dev
```

Another alternative:

```
chmod 777 /dev/bus/usb –recursive

ls -l | grep lego
```

PENDING

4.2.4.- Compile leJOS project.

Compile leJOS project and compile

```
cd /media/disk/robotics/nxj/lejos_nxj/build
ant
```

PENDING
Exception in thread "main" java.lang.NoClassDefFoundError:
org/apache/tools/ant/launch/Launcher
Caused by: java.lang.ClassNotFoundException:
org.apache.tools.ant.launch.Launcher
at java.net.URLClassLoader$1.run(URLClassLoader.java:200)
at java.security.AccessController.doPrivileged(Native Method)
at java.net.URLClassLoader.findClass(URLClassLoader.java:188)
at java.lang.ClassLoader.loadClass(ClassLoader.java:306)
at sun.misc.Launcher$AppClassLoader.loadClass(Launcher.java:276)
at java.lang.ClassLoader.loadClass(ClassLoader.java:251)
at java.lang.ClassLoader.loadClassInternal(ClassLoader.java:319)

4.3.- Test leJOS

Once you have configurated Ubuntu to develop leJOS software for EeePC or NXT Brick we compile software using the package pccomm.jar and software to deliver to NXT Brick.

4.3.1.- Examples to test

In this example we run a leJOS program on Ubuntu and another program on NXT brick:

4.3.1.1.- USBSend

The USBSend Example is a simple class developed by Lawrie Griffiths to manage USB connection between a PC and NXT Brick.

```
import lejos.pc.comm.*;
import java.io.*;

/**
 * This is a PC sample. It connects to the NXT, and then
 * sends an integer and waits for a reply, 100 times.
 *
 * Compile this program with javac (not nxjc), and run it
 * with java.
 *
 * You need pccomm.jar on the CLASSPATH and the jlibnxt
 * DLL or shared library on the Java library path.
 *
 * Run the program by:
 *
 *   java USBSend
 *
 * Your NXT should be running a sample such as USBReceive.
 *
 * @author Lawrie Griffiths
 *
 */
public class USBSend {

      public static void main(String[] args) {
            NXTComm nxtComm =
NXTCommFactory.createNXTComm(NXTCommFactory.USB);

            NXTInfo[] nxtInfo = null;

            try {
                  nxtInfo = nxtComm.search(null, NXTCommFactory.USB);
            } catch (NXTCommException e) {
                  System.out.println("Exception in search");
            }

            if (nxtInfo.length == 0) {
                  System.out.println("No NXT Found");
                  System.exit(1);
            }

            try {
                  nxtComm.open(nxtInfo[0]);
            } catch (NXTCommException e) {
                  System.out.println("Exception in open");
            }

            InputStream is = nxtComm.getInputStream();
            OutputStream os = nxtComm.getOutputStream();
            DataInputStream inDat = new DataInputStream(is);
            DataOutputStream outDat = new DataOutputStream(os);
            int x = 0;
            for(int i=0;i<100;i++)
            {
                  try {
```

```
                    outDat.writeInt(i);
                    outDat.flush();

                  } catch (IOException ioe) {
                        System.out.println("IO Exception writing
bytes");
                  }
                try {x = inDat.readInt();}
                catch (IOException ioe) {
                  System.out.println("IO Exception reading reply");
                }
              System.out.println("Sent "+i+ " Received "+x);
            }

            try {
                  inDat.close();
                  outDat.close();
            } catch (IOException ioe) {
                  System.out.println("IO Exception Closing
connection");
            }

            try {
                  Thread.sleep(1000);
            } catch (InterruptedException ie) {}

            try {
                  nxtComm.close();
            } catch (IOException ioe) {}
      }

}
```

To compile and use the example:

```
javac -classpath "/usr/share/java/pccomm.jar" USBSend.java
java -classpath "/usr/share/java/pccomm.jar:." -
Djava.library.path=/media/disk/robotics/nxj/lejos_nxj/bin USBSend
```

4.3.1.2.- USBReceive

The example USBReceive is an example that runs on NXT Brick to receive data from a PC.

```
import lejos.nxt.*;
import java.io.*;
import lejos.nxt.comm.*;

/**
 * Test of Java streams over USB.
 * Run the PC example, USBSend, to send data.
 *
 * @author Lawrie Griffiths
 *
 */
public class USBReceive {

      public static void main(String [] args) throws Exception
```

```
	{
		LCD.drawString("waiting", 0, 0);
		USBConnection conn = USB.waitForConnection();
		DataOutputStream dOut = conn.openDataOutputStream();
		DataInputStream dIn = conn.openDataInputStream();

		while (true)
		{
		int b;
		try
		{
		    b = dIn.readInt();
		}
		catch (EOFException e)
		{
		    break;
		}
		      dOut.writeInt(-b);
		      dOut.flush();
		  LCD.drawInt((int)b,8,0,1);
		}
	}
}
```

5.- Links

5.1.- Linux

Ubuntu
http://www.ubuntu.com/GetUbuntu/download
http://code.google.com/p/eee-ubuntu-support/issues/detail?id=9

SSH, Putty & WinSCP
https://help.ubuntu.com/7.10/server/C/openssh-server.html
http://www.chiark.greenend.org.uk/~sgtatham/putty/
http://winscp.net/eng/index.php

5.2.- Java

https://help.ubuntu.com/community/Java
https://help.ubuntu.com/community/JavaInstallation
http://sourceforge.net/projects/javajoystick/
http://www.chuidiang.com/java/novatos/hacer_ficheros_jar.php
http://www.chuidiang.com/java/novatos/hacer_ficheros_jar.php#manifiesto

5.3.- NXT & leJOS

http://www.ecst.csuchico.edu/~juliano/Research/Blog/nxt.html
http://weblogs.java.net/blog/jfalkner/archive/2008/02/controlling_leg_1.html
http://jan.kollhof.net/wiki/projects/Lego/linux

5.4.- Articles

http://www.foroz.org/foroz/topic39882.html
http://ubuntulife.wordpress.com/2008/05/06/instalar-javaeclipsetomcat-en-ubuntu-804/
http://www.hnkweb.com/2008/05/16/instalar-ubuntu-804-en-el-eee-pc-900/#comment-3414
http://weblogs.java.net/blog/jfalkner/archive/2008/02/controlling_leg_1.html
http://www.hnkweb.com/2008/05/16/instalar-ubuntu-804-en-el-eee-pc-900/#comment-3414
http://daviddelprado.blogspot.com/2008/05/vmware-en-ubuntu-804.html
http://www.markdbd.com/2006/12/18/como-mantener-limpio-ubuntu-i-con-deborphan/
http://daviddelprado.blogspot.com/2008/05/vmware-en-ubuntu-804.html