

# Lecture notes on Package Management Systems and software installation

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**(under construction)**

# Agenda



# Introduction

- A GNU/Linux distribution is...?

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- A GNU/Linux distribution is...?
  - It's not UNIX !
  - It's a collection of software that usually provides a complete system. It offers installation tools and is based on the Linux kernel.
    - Linux Kernel
    - Libraries
    - Shell
    - Utilities
    - User programs



# Introduction

- Most common source of ERRORS in software installation:
  - **missing library**
    - If a program A needs library X and library X is not installed, program A WILL NOT BE EXECUTED
  - **missing program**
    - If program A needs program B and program B is not installed, program A WILL NOT BE EXECUTED

# Libraries: static x dynamic

- Library
  - Static
  - Dynamic
- Test experiment

# Dynamic Libraries

- Files ending in `.so` (shared object)
- Trusted directories:
  - `/lib{,64}`
  - `/usr/lib{,64}`
- `/etc/ld.so.cache` - File (“binary”) that keeps an ordered list of library-names/file-names found in the following places (binary search):
  - `/etc/ld.so.conf` - File (text) that keeps the list of directories in the system that owns libraries
  - Trusted directories



# Dynamic Libraries

- Search order
  - LD\_LIBRARY\_PATH
  - /etc/ld.so.cache
  - /lib{,64}
  - /usr/lib{,64}

# Dynamic Libraries

- Tools
  - `ldconfig` (recreates cache - `ld.so.cache`)
  - `ldconfig -p` (lists current cache)
  - `readelf` (extracts information from ELF files)
    - Ex.: check libraries that a program needs:
      - `readelf -d /usr/bin/vim | grep NEEDED`
  - `objdump -p /usr/bin/vim | grep NEEDED`
  - `ldd /usr/bin/vim`
  - `/lib64/ld-linux-x86-64.so.2 --list /usr/bin/vim`

# Dynamic Libraries

- Library name created by the Linux distribution x  
Library soname
- Ex.:
  - Linux Distribution Lib Name: `libc.so.2.22`
    - first number is the MAJOR NUMBER (it's always changed when it breaks compatibility with older version)
    - last number is the RELEASE NUMBER (or MINOR NUMBER - compatible with other MINOR NUMBERS)
  - Library soname: `libc.so.2`
    - `readelf -d /lib64/libc.so.2.22 | grep SONAME`
- `ldconfig` uses soname to create appropriate links

# Definitions

- Most common operations
  - Installation, removal, update
- Installation methods
  - Source code (It's necessary to compile the source code)
  - Binary (It's necessary to download the right binary for the target platform: CPU architecture, operating system, etc.)
- Software distribution
  - (Linux) Distribution INDEPENDENT package (Ex.: .tar)
  - (Linux) Distribution DEPENDENT package (Ex.: .deb)

# Definitions

- Software Dependency Resolution
  - Requirements verification for the installation of some software
    - Which libraries and other softwares must be installed in order to this software work?
  - How to verify?
    - Manual verification
    - Automatic verification

# Packages

- Package types (formats)
  - Common to all (Linux) distributions: .tar, .tar.gz, .tar.bz2, etc..
  - Most common package types
    - .deb → Systems based on Debian (Debian, Ubuntu, etc..)
    - .rpm → Systems based on RedHat (CentOS, Mandriva, **Fedora**, **RHEL**)
    - .txz (former: .tgz) → Slackware
    - .pkg.tar.xz → ArchLinux

# Packages

Tool	Package type	Automatic Dependency resolution?
dpkg	.deb	no
apt-get (dpkg “front-end”)	.deb	yes
synaptic (apt-get front-end)	.deb	yes
aptitude (apt-get front-end)	.deb	yes
rpm	.rpm	no
yum (rpm front-end)	.rpm	yes
installpkg, removepkg, etc...	.tgz, .txz	NO
pacman	.pkg.tar.xz	yes

# Packages - Debian package format

- Tradicional UNIX ar file
- Contains 3 elements:
  - debian-binary (text file showing the debian package version - 2.0)
  - control.tar.gz (contains the “recipe” to the package installation)
  - data.tar.gz (contains the files of the software to be installed)



# Package: Resolving dependency in Debian

- Ex.: `package nano_2.2.6-1+b1_amd64.deb`
  - `ar vx nano_2.2.6-1+b1_amd64.deb`
    - files: `debian-binary`, `control.tar.gz`, `data.tar.gz`
  - `mkdir control; cd control; tar -xvzf ../control.tar.gz`
  - `ls`
    - `conffiles`, `control`, `md5sums` `postinst`, `postrm`, `preinst`, `prerm`
  - `cat control` (next-slide)

# Packages: Resolving dependency in Debian

Package: nano

Source: nano (2.2.6-1)

Version: 2.2.6-1+b1

Architecture: amd64

Maintainer: Jordi Mallach <jordi@debian.org>

Installed-Size: 1664

**Depends:** libc6 (>= 2.3.4), libncursesw5 (>= 5.6+20070908), libtinfo5, dpkg (>= 1.15.4) | install-info

Suggests: spell

Conflicts: pico

Breaks: alpine-pico (<= 2.00+dfsg-5)

Replaces: pico

Provides: editor

Section: editors

Priority: important

Homepage: <http://www.nano-editor.org/>

Description: small, friendly text editor inspired by Pico

GNU nano is an easy-to-use text editor originally designed as a replacement for Pico, the ncurses-based editor from the non-free mailer package Pine (itself now available under the Apache License as Alpine).

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However, nano also implements many features missing in pico, including:

- feature toggles;
- interactive search and replace (with regular expression support);
- go to line (and column) command;
- auto-indentation and color syntax-highlighting;
- filename tab-completion and support for multiple buffers;
- full internationalization support.

# Packages

- Package repository
  - Each package management tool uses a file that configures the list of package repositories.
  - APT example: `/etc/apt/sources.list`

```
deb cdrom:[Debian GNU/Linux 6.0.1a _Squeeze_ - Official i386 DVD
Binary-1 20110322-15:11]/ squeeze contrib main
deb http://debian.las.ic.unicamp.br/debian/ squeeze main
deb-src http://debian.las.ic.unicamp.br/debian/ squeeze main
deb http://security.debian.org/ squeeze/updates main contrib
deb-src http://security.debian.org/ squeeze/updates main contrib
# squeeze-updates, previously known as 'volatile'
deb http://debian.las.ic.unicamp.br/debian/ squeeze-updates main contrib
deb-src http://debian.las.ic.unicamp.br/debian/ squeeze-updates main contrib
deb http://ftp.br.debian.org/debian/ lenny main contrib non-free
deb http://www.debian-multimedia.org squeeze main non-free
```

# Source code

- Installation from source code (overview):
  1. Unpack
  2. `.cd` to source code directory
  3. List configuration options: `./configure --help`
  4. Configure: `./configure <several options>`
  5. Compile: `make`
  6. Install: `make install`