Linux operating system

libre, free: how and why

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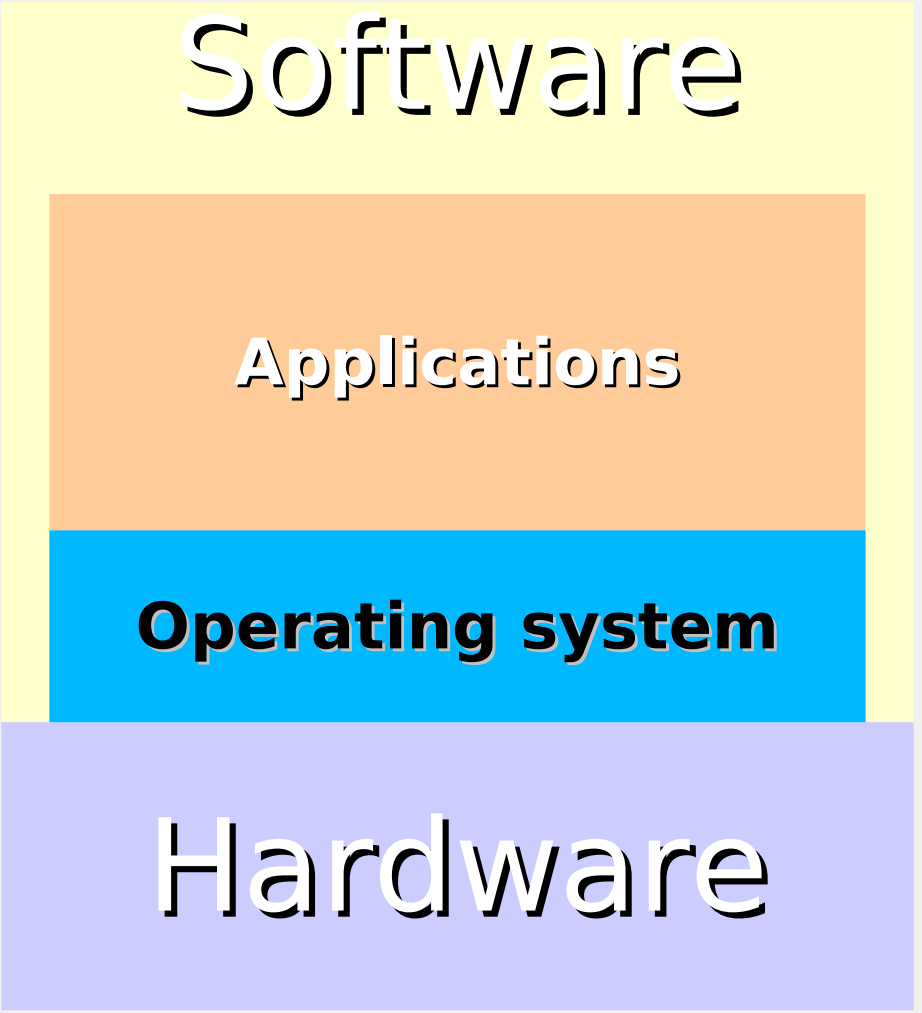
Don't panic!

- What is operating system?
- GNU/Linux
- Licences: GPL, Open Source
- Evolution of open source software
- How is all of this connected with bioinformatics?

Operating system?

- An operating system (OS) is a set of computer **programs** that **manage** the **hardware** and **software** resources of a computer
- The operating system forms a **platform for** other system software and for application **software**.



History
GPL license
Open Source

Linux and GNU project

- Operating system
  - Linux kernel
    - kernel alone isn't enough
  - GNU user-land
- Applications
  - GNU C compiler
  - GPL applications on top of it

We all know Linux is great. It does infinite loops in 5 seconds. --Linus

GNU project

- 1983
  - Richard M. Stallman begins development of free Unix compatible operating system
- 1990
  - most of the components (libraries, compilers, shells) are finished
  - development of GNU Hurd kernel starts (still pending)

Linux history from 1991.

- Linus Torvalds wanted OS compatible with Unix for his i386 PC
- Unix is based on POSIX standards
- rapid releases on Internet under GPL license
- result is POSIX complaint OS

If you want to travel around the world and be invited to speak at a lot of different places, just write a Unix operating system. --Linus

4 GPL freedoms

0: to run the program, for any purpose

1: to study how the program works, and adapt it to your needs (source code)

2: to redistribute copies so you can help your neighbor

3: to improve the program, and release your improvements to the public, so that the whole community benefits (source code)

GPL license and source code

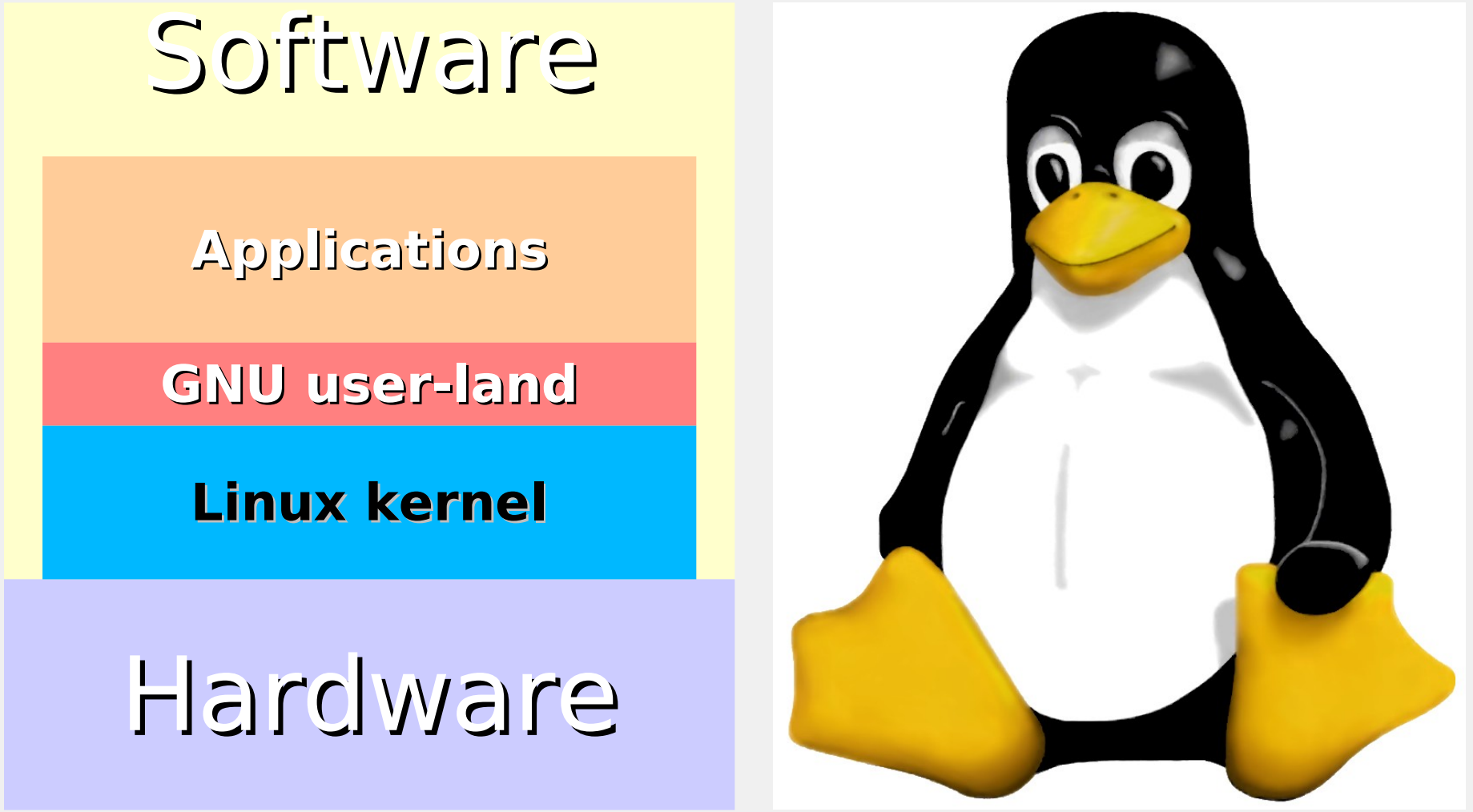
GPL is viral: sharing of changes in GPL software is requirement to the benefit of community

Basically, I want people to know that when they use binary-only modules, it's THEIR problem. I want people to know that in their bones, and I want it shouted out from the rooftops. I want people to wake up in a cold sweat every once in a while if they use binary-only modules. --Linus

GPL is viral

- How software evolves?
- Every change (improvement, adaptation) is evolution step
- Changes are exchanged
- Enviroment change kills with out ability to study, change and modify
  - change of operating system
  - hardware platform change
- Backward compatibility is myth!

Linux


Software
Applications
GNU user-land
Linux kernel
Hardware

Linux FUD*

- It works different than Windows
  - some would call this benefit :-)
- Hard to install, hardware support
  - try recent distribution (eg. Ubuntu)
- It looks strange
  - Gnome, KDE, XFCE ...
- something free can't be good
  - ?

* FUD = http://en.wikipedia.org/wiki/**Fear,_uncertainty_and_doubt**

Kernel versions

- history
  - stable (1.0, 1.2, 2.0*, 2.2, 2.4, 2.6)
  - development (0.9, 1.1, 1.3, 2.1, 2.3, 2.5)
- 2.6.X – stable (in distributions)
- 2.6.X-rcY – development (git)

*) released in 1996. with 64 bit support for Alpha CPU

'Fewer fundamental changes' is a mark of a system that isn't evolving as quickly, and that is reaching middle age. We are probably not quite there yet --Linus

Device support

- PDA
- smart phones (Android)
- ADSL modems
- set-top boxes (IPTV)
- Computers or any size: laptop, desktops, servers, clusters, super-computers...

- supports more than 20 CPU architectures

GNU/Linux distributions

- Collection of software which you install on computer
  - Linux kernel
  - GNU user-land
  - GPL or commercial applications
- free and libre
  - Debian, Ubuntu, Fedora, Gentoo
- Commercial with support
  - RedHat Advanced Server, SuSE, LSB

Applications

- solving new problems require innovative solutions
- balance between learning and customizations (power users)

- desktop
  - office tasks (OpenOffice.org), web (Firefox), video (VLC), pictures (GIMP)...
- servers
  - web servers, web services (Google)

Software development

- Cathedral
  - source available in incremental releases
  - developed by tight group of developers
- Bazaar
  - public view of source on Internet
  - rapid quick releases

Linus' law: given enough eyeballs, all bugs are shallow

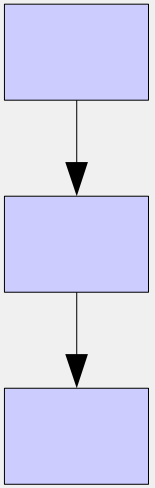
Programming languages

Ada awk Brainf*ck Basic C C++ Erlang Forth GNAT Haskell Java KL1 KMFL Lisp Logo Lua ML Oberon-2 OCaml Perl PHP Pike PostScript Prolog Python Ruby Scala Scheme sh SPL TCL

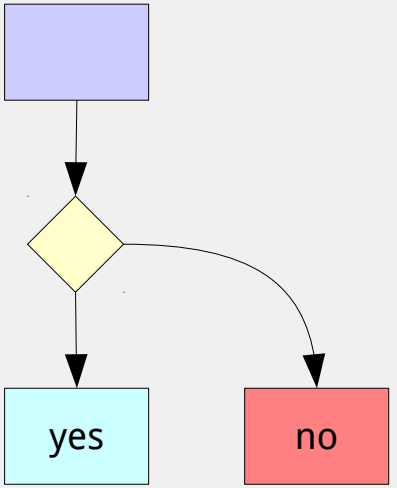
...

Basic programming

- Simple basic building blocks which enable us to describe desired behavior (algorithm) to computer



sequence



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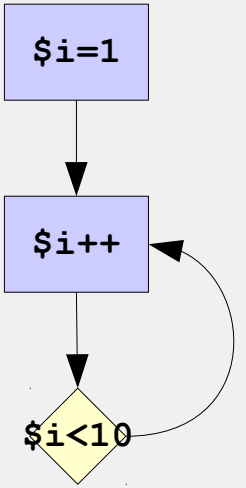


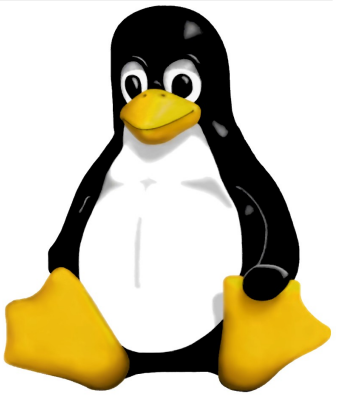
loop

Open standards

- Operating systems based on POSIX – enables compilation of same code on different architectures
- Exchange of data
  - formats (ASCII, XML, JSON, ...)
  - protocols (HTTP, SOAP, REST, ...)

Linux and Biology

- Biology in different mediums
  - in vitro – in glass
  - in vivo – in life
  - in silico – in computer algorithms
- Huge amount of experimental data
  - collected, shared, analyzed
  - biologists forced to relay on computers



Computational biology

- using simulations to check assumptions
- computer as a tool

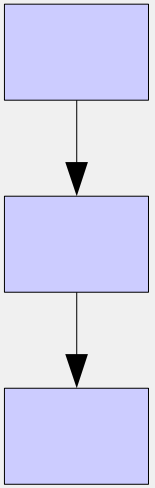
- NCBI provides DNA sequence search using web service
- BLAST – well known search algorithm
- with simple perl or python script you can start right away!

Bioinformatics

- Information technologies used for biology
- different programming languages
- specialized libraries
  - BioPerl
  - BioJava
  - BioBike (LISP)
- access to data through Web services

Thinkering

- Linux is ready to be run, studied, redistributed and modified (GPL freedoms) to suit your needs



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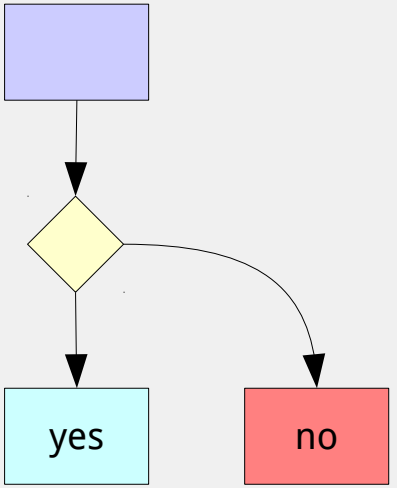

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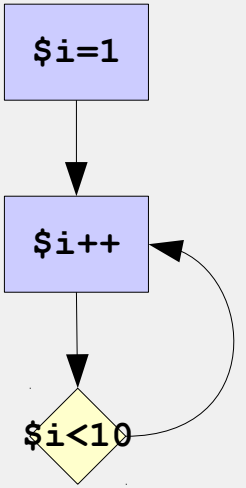


loop

Open Source culture

- ides are too universal to be used only in software development
  - free culture
  - science
  - education
  - politics
- Creative Commons
  - set of licenses for content

Digital Rights Management

- Digital **Restrictions** Management
- DRM enable **chain of trust** between **hardware** manufacturer, **software** supplier and **content** provider
- **User** is left out of this equation (no control whatsoever), so he can just **rent** services, not own anything (can't even change hardware configuration – like bolted car hub)

DRM in decline

- October 28, 1998 DMCA anti-circumvention
- March 31, 1999 Tivo TV time-shifting device
- October 1999: DeCSS for DVDs
- November 28, 2001: 2600, sued for linking to the DeCSS code
- July 16, 2001: Adobe ebooks arrest
- September 8, 2003: RIAA sues 261 file sharers
- January 22, 2004: DVD Jon proceedings dropped
- October 31, 2005: Sony Rootkit discovered
- April 2007: AACS key for HD DVDs published
- September 25, 2007: Amazon selling DRM-free MP3s.
- July 11, 2008: Apple's App Store for iPhone and iPod
- February 27, 2009: Amazon removes text-to-speesh from Kindle
- April 7, 2009: Apple announces DRM-free iTunes Store
- July 11, 2009: Amazon deletes Orwell's 1984 from Kindle

Patents

- doesn't protect small inventor
- slows down software development
- mostly used as deterrent against other patents
- problem of innovative **ideas** in society where everybody **builds on work of others** (prior art)
- limited in length (hence, slowdown as opposed to standstill with copyright)

Is Linux for me?

- Free operating system with applications and development tools
- Ability to study how things works, at source code level
- Freedom to thinker with technology
- Direct commands allow automation using scripts
- Source code allows modifications of how applications work

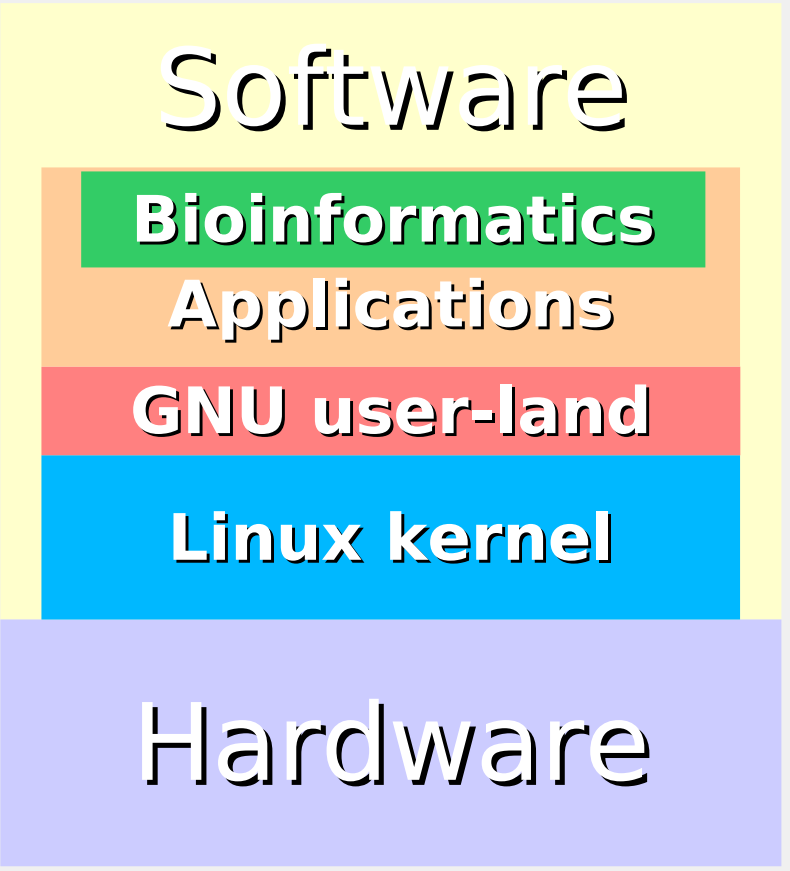
Where is the money?

- Commodity infrastructure
  - OS, web server, database
- Innovative services (Google)
- Quick to innovate
  - alpha geeks

I'm never in the situation where I have to make a priority-decision between Linux and money - all my Linux-related work can be done purely on technical issues rather than having any "marketing" issues pop up. --Linus

Review

- Linux kernel
- GNU project
- GPL license (4 freedoms)
- Distributions
- Customizations
- Bioinformatics, computational biology
- DRM, patents



cooperation is only way to **progress** and **sharing** is only way of cooperation

Find out more...

- E.S. Raymond: "**The Cathedral and the Bazaar**", http://www.catb.org/~esr/writings/cathedral-bazaar/
- Pekka Himanen: "**The Hacker Ethic and the Spirit of the Information Age"**, ISBN 0-375-50566-0
- Feller, B. Fitzgerald, S. A. Hissam and K. R. Lakhani: **"Perspectives on Free and Open Source Software"**, MIT Press, http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=11216&r
- D.E. Geer, C.P Pfleeger, B. Schneier, J.S. Quarterman, P. Metzger, R. Bace, P Gutmann: "**Cyberinsecurity: The Cost of Monopoly --How the Dominance of Microsoft's Products Poses a Risk to Security,"** Computer and Communications Industry Association, September 24, 2003: http://www.ccianet.org/papers/cyberinsecurity.pdf

Questions?
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