FOSSH is the only answer for Education

by

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Who Am I?


• In the computer industry since 1969
  – Mainframes 5 years
  – Unix since 1980
  – Linux since 1994

• Companies (mostly large): Aetna Life and Casualty, *Bell Labs*, Digital Equipment Corporation, SGI, IBM, Linaro, LPI, OptDyn

• Programmer, Systems Administrator, Systems Engineer, Product Manager, Technical Marketing Manager, *University Educator*, Author, *Businessperson*

• Extremely large systems to extremely small ones

• *Pragmatic*

• Vendor *and* a customer
Who Am I: Linux

- May 1994 – funded Linus Torvalds at DECUS
  - Obtained Alpha for Linus to do port
    - CISC/RISC
    - 32/64 bit
  - Assembled DEC engineering team
- 1995 – Assumed ED role for Linux International
  - LMI – defended Linux Trademark
  - LPI – helped found Open Source Professional certification program
  - July 2016 - Board Chair
    - LSB – Linux Standard Base
- Promote Linux and FOSSH Worldwide
Let Me Introduce You To A Few Friends....

- Enterprise Creator – 22
- President - 21
- Kernel Developer – 15
- Distribution Developer - 14
- Soweto Entrepreneur – 22
- Distribution Developer - 12
My Latest Hero: Marcelo Balisteri
Favela Vila Parque da Cidade in Rio de Janeiro

- Taught himself computers
- Taught himself networking
- Started Wireless ISP in favela
- Started school for training young people
- Now working for University in Rio
What Are Goals of Education?

_Not to “get a job”_

- Create:
  - Thinking Voters
  - Thinking Workforce
  - Lifetime learning

- Research
  - Public Research with Public money
  - Private Research with Private money
    - Even then, sometimes it is “public”...
Research to Product

- Pure Research
- Directed Research
- Advanced Development
- Product Development
- Sustaining Engineering
What To Teach and Not To Teach: That Is The Question

- Teach networking standards and implementation
  - Not Cisco networking
- Teach how to select and use office products
  - Not Microsoft Office
- Databases and Data structures
  - Not Oracle Database
- Telephony
  - Not Nortel Communications
That Having Been Said:

- You can make money with Open Source all the ways that you can make money with closed source
  - Install, Integrate, educate, administer, consult
- And one more way:
  - Change the software to meet the customer's needs
- Local programming to create local jobs
Billions of \textit{USD, Reais, Euros}

- Brazil pirates 84\% of desktop software
  - “Mr. maddog, all of our software is free...”
  - ....but when it comes to the software that they have written....

- Billions of Reais leave Brazil for software (and hardware) that could have produced local jobs
People Do Not Buy Hardware and Software
People Do Not Buy Hardware and Software

They buy solutions......
While We Are Talking Costs:
There Is No Such Thing As “Free”

- Cost of electricity
- Cost of training
- Cost of hardware
  - Cost of upgrades (when needed)
- Cost to your suppliers (who do buy licenses)
Four Functions Of Educational Body

- Set a *path* of objectives
- *Teach* to these objectives
- *Certify* that people have retained and can use the knowledge
- *Research* new objectives
Multitude of Paths For “University Education”

- Cooperative Education
- Guild Program
  - Apprentice
  - Journeyman
  - Master Craftsman
- Mentorship
- Self-learning
  - Online courses (MIT, Rice, Stanford...)

Copyright Linux International 2019
What Is Free Culture and How Can It Help?

- Free and Open Standards
  - Enable interoperability and longevity
- Free and Open Source Software
  - Reduce costs
  - Allow real-life projects (*fun* and *useful*)
  - Share those projects with those that need them
Not Just “Free Software”: Free Culture

- Creative Commons
  - Music
  - ART
  - Photographs
  - Text
- Open Hardware
  - Sharing Design and testing
K-12

DebianEdu/Skolelinux
Should Everyone Learn To Program?

- Everyone should learn to write a simple program
  - Learn “computer logic”
  - Learn how to talk to a programmer
- Learn to gage if the task is “easy” or “hard”
Which Should Be The First Languages? (Which is better: vi or emacs?)

- Scratch/Turtle-Logo
- bash (Bourne Again Shell) and utilities
  - Every GNU/Linux distribution
  - Very Powerful
  - Helps with Systems Administration
- Python
- Assembler (What, are you crazy?)
- “C” (C++, Objective C, etc.)
IEEE/ACM Computer Engineering Curricula (2016)

- Course Number
- Course Description
- Objectives
- Suggested Texts
- Prerequisites
A Complete Computer Engineering Curriculum Using Open Source Software

• Operating Systems Design
  - Kernels
    • FreeDOS – www.freedos.org
    • Linux (GNU/Linux and Android)
    • *BSD
    • FreeBSD, NetBSD, OpenBSD
    • TinyOS – http://tinyos.net
    • CMU MACH
    • Hurd
A Complete Computer Science Curriculum (Cont.)

• Operating Systems Design (Cont.)
  - Multi
    • user
    • tasking
    • threaded
    • architecture
  - memory managed and not
    • 32 and 64 bit
Operating System Design (Cont.)

• Filesystems
  - FAT (FAT-16, FAT-32, VFAT, etc.)
  - NTSC
  - Unix
  - Log-based
  - Journaled

• Networked file systems
  - NFS, SAMBA
Operating System Design (Cont.)

• Networking
  - TCP/IP
  - X.25
  - Appletalk
  - SMB
  - DECNET
  - 802.11x
  - IR
  - Bluetooth
Operating System Design (Cont.)

• Security aspects
  - Kerberos
  - SELinux
  - Apparmor

• Graphics
  - X Window System
  - OpenGL

• Clustered systems (HPC and HA)

• Virtualization (Xen and KVM)

• Emulators – Wine, QEMU
Cloud Software And Services

- NextCloud
- OpenCloud
- Apache Webserver
FOSS Not Just “An Operating System”

- Compilers
  - “C”, C++, Fortran, Pascal, Lisp, Ada (gnat), Hadoop, Prolog, Lua, etc.
- Interpreters
  - Python, Perl, Ruby, Tcl/Tk, PHP
- Database engines (Ingres, MySQL, PostgreSQL, CouchDB, other types)
- Office Systems
- Multimedia tools (music, video, MIDI)
- Statistical tools such as “R”
- VoIP
SourceForge/GitHub/GitLab

430K+ projects
3.4M+ developers

Without China, India, Latin America, etc. being fully on connected to Internet
What Types of Programs?

- Audio & Video
- Business & Enterprise
- Communications
- Development
- Home & Education
- Games
- Science & Engineering
- Security & Utilities
- Systems Administration
- Emulators and Simulators
Open Source

• Build on top of other programs
  - Not just whole programs, parts of programs
• Meet other people of like interest
• Research can go faster, since large portions of existing code might be used freely
Examples of Issues In Sharing Research Projects

- 64-bit OS
- Clustering
- Genome research and Oracle
- Soweto, Adobe and Digital Photography
- Educational Licensing and Cooperative Education
- “International” versions of the software
  - MySQL and Dual Licensing
- BSA (and I do not mean the Boy Scouts of America)
Why Do I Show You All This?
Because Of THIS!

- 12 ARMv7 Cores at 1 GHz each
- 6 GBytes of RAM
- 6 HDMI ports
- 6 SATA ports (currently driving two disks)
- IR on board
- 2 TB SATA disk
- 8 Port Gbit ETHERNET
- 70 Watts
- Fits in standard briefcase
Why Is This Interesting?

- Can be used to teach HPC computing
- Can be used to teach HA computing
- Can be used to teach heterogeneous computing
- Can be used to teach heterogeneous systems administration
- Very portable, can be assembled in minutes
- Very modular
- Prototype cost: 500 USD – in USA – would normally cost much more in Latin America
  - Currently using “Banana Pi” - soon Caninos Loucos Labradors
- Production cost: < 600 USD – would normally cost about 1200 USD in Latin America
  - Will soon use (7) Labradors
  - Will increase from 12 to 32 ARM-32 cores
- With the program to manufacture here will cost approximately the same in Latin America as in Taiwan.
Computer Education For All
Curriculum In A Box

- Two SBCs
  - Each (in turn) can act as a
    - Server or client
    - Development platform or target
    - IoT training platform
  - One 32 bit
  - One 64 bit
  - Virtual machine capable
  - 5-19V, less than 18 watts each
- Add LCD monitor, keyboard, mouse
Proposal: IEEE/ACM Curriculum Using FOSSH

• Utilizes “Curriculum in a box”
  - Materials installed on two USB Flash sticks
  - No server needed
    • Blockchain Router has NAS capabilities
  - No high speed network needed
    • Only updates to materials downloaded
Curriculum In A Box
Combining Arduino and Single Board Computers (SBCs)
Additionally

- All cables needed
- Prototyping board, sensors and jumper wires
- Two USB flash memories
  - All course materials
  - Various distributions
  - Source code as needed
- Minimal Internet connection useful, but not needed
- Solar power capable
Low Cost and Reusable

- Could be sold to end customer
- Could be rented and returned
  - Rental organization checks contents
  - Rental organization updates USB flash
- Could be subsidized by government and industry
- Currently China and Brazil, could also be Argentina and Uruguay
More Than Just Software: Open Processes

• Free and Open Standards
  – www.openstandards.org
• Linux Professional Institute
  – www.lpi.org
• Open Buglists
• Open Mailing Lists
• Open Developers Lists
Burlington University: Asterisk, Sip and VoIP

- “Let them teach you”
  - Open Source teaches twice or three times
- Encourage students to set up “networks”
- Allow them to do fun projects
What About “Certification”?  

- LPI – Linux Professional Institute  
  - www.lpi.org  
- Portfolio  
  - programs  
  - email  
- Letters of recommendation
Script Kiddies – Hackerteen
4Linux
Business Courses Also Need Updating

- Business models with Open Source
- Software Licensing
- Collaborative Development
- Cyber Ethics
  - Software Piracy is bad
  - Stealing music is bad
  - Stealing books is bad
**IoT**

- Brazilian National Program IoT
  - 1% of population trained
  - Many sub-programs
- Caninos Loucos is Hardware Platform for IoT
  - Goals of completely open system
- [www.codeiot.org.br](http://www.codeiot.org.br) – 70K trained
  - Portuguese, English and Spanish
Summary: Use Of Open Source In Education

- Allows students to see HOW the software does its work, not just what it does -
  - “You need to understand your tools” - Andy Nagle, Microsoft
- Encourages collaboration
- Allows students to use same software everywhere
- Makes sharing of research much easier
- Reduces amount of work for incidental software
Questions?