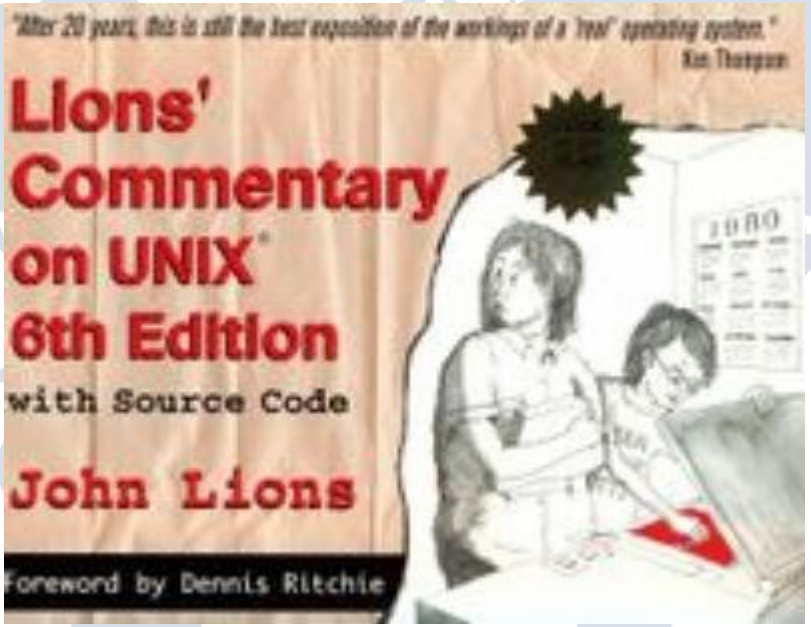
Computer Education Revisited: A Comprehensive System of Education Using Free Culture

by

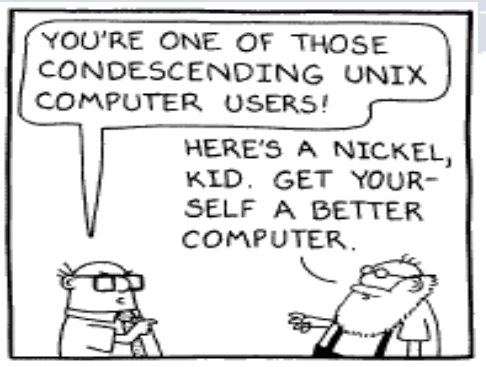
Jon "maddog" Hall
Executive Director
Linux® International®

Dedicated to: John Lions



Who Am I?

- *Half* Electrical Engineer, *Half* Business, *Half* Computer Software
- 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
- ***Programmer***, Systems Administrator, Systems Engineer, Product Manager, Technical Marketing Manager, ***University Educator***, Author, Businessperson, Consultant
- ***Taught OS design and compiler design among other courses.***
- *Extremely* large systems to *extremely* small ones
- Pragmatic
- Vendor *and* a customer

What Gives These Value?

What Gives This Value?

El MOVIMIENTO BIBLICO DIOCESANO

OTORGA EL PRESENTE

DIPLOMA

A D. _____,

en testimonio de haber realizado, con aprovechamiento, los siguientes CURSOS BIBLICOS:

Primer Curso: **Las grandes experiencias de Israel**

Segundo Curso: **San Pablo y las primeras comunidades cristianas**

Tercer Curso: **Los cuatro Evangelios**

En Lugo, a _____ de _____ de _____

El Excmo. Sr. Obispo,

El Director de la Escuela Bíblica,

I Am An Ordained Priest

Introducing You To A Few Friends:

Would Closed Source allow them to...?

- Enterprise Creator – 22
- President - 21
- Kernel Developer – 12
- 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
- Started MakeIT lab

What Are Goals of Education?

- Create a:
  - Thinking Electorate
  - Thinking Workforce
  - Lifetime knowledge
- Research
  - Public Research with Public money
  - Private Research with Private money
    - Even then, sometimes it is “public”…

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

Setting The Path To Education

College catalogs published on Internet

- Courses needed for a degree
- Book lists for each course
- Sometimes lecture materials

What To Teach and Not To Teach: That Is The Question

- Teach networking standards and implementation
  - *Not* just Cisco networking
- Teach how to select and use office products
  - *Not just* Microsoft Office
- Databases and Data structures
  - *Not* just Oracle Database
- Telephony
  - *Not Just* Nortel Communications

What Is Free Culture and How Can It Help?

- Free and Open Source Software
  - Reduce costs
  - Allow real-life projects (*fun* and *useful*)
- Free and Open Standards
  - Enable interoperability and longevity
- Creative Commons
- Free and Open Hardware

K-12

- K12Linux – LTSP plus Fedora
  - http://fedorahosted.org/k12linux/
- Edubuntu.org
- Poseidon Linux – scientific
  - GIS, 3D Visualization, Mathematics, Statistics, Genetics, Bio-Informatics, other research
  - Portuguese, Spanish, English, German, Greek, Italian, French

University

Computer Science

A Complete Computer Science Curriculum

- Operating Systems Design
  - Kernels
    - Linux
    - *BSD
    - FreeBSD, NetBSD, OpenBSD
    - FreeDOS
      - www.freedos.org
    - 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
  - Distributed file systems
- Networked file systems
  - NFS, SAMBA

Operating System Design (Cont.)

- Networking
  - TCP/IP
  - X.25
  - Appletalk
  - SMB
  - DECNET
  - 802.11x
  - IR
  - Bluetooth

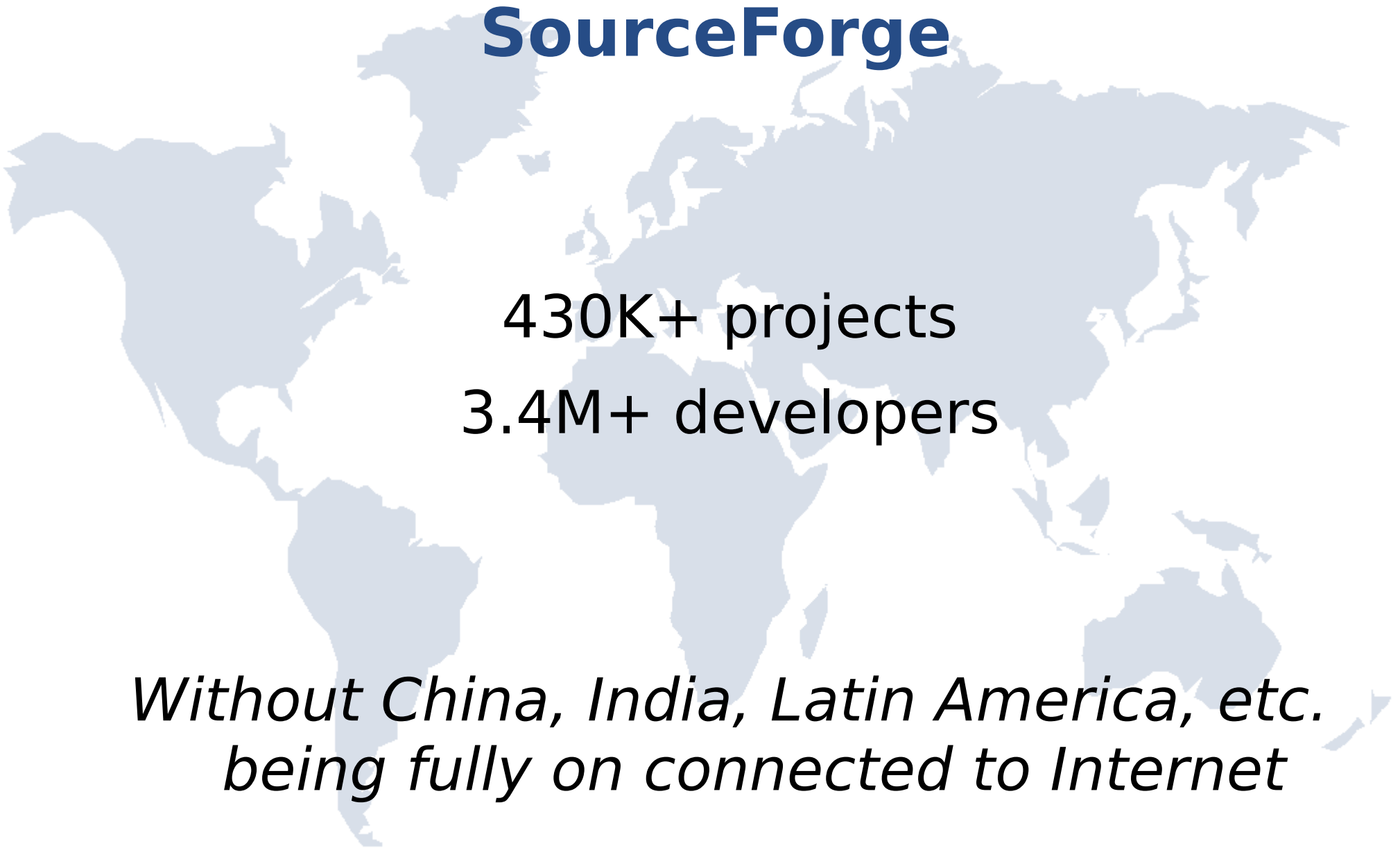
Operating System Design (Cont.)

- Security aspects
  - SELinux
  - AppArmor
  - Kerberos
- Graphics
  - X Window System
  - OpenGL
- Clustered systems (HPC and HA)
- Virtualization (Xen and KVM)
- Emulators – Wine, BOCHS, QEMU

FOSS Not Just “An Operating System”

- Compilers
  - “C”, C++, Fortran, Pascal, Lisp, BASIC, Hascal etc.
- Interpreters
  - Python, Perl, Ruby, Tcl/Tk
- Database engines
- Office Systems
- Multimedia tools
- VoIP

SourceForge



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

SourceForge

- 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

More Things To Teach (and not teach)

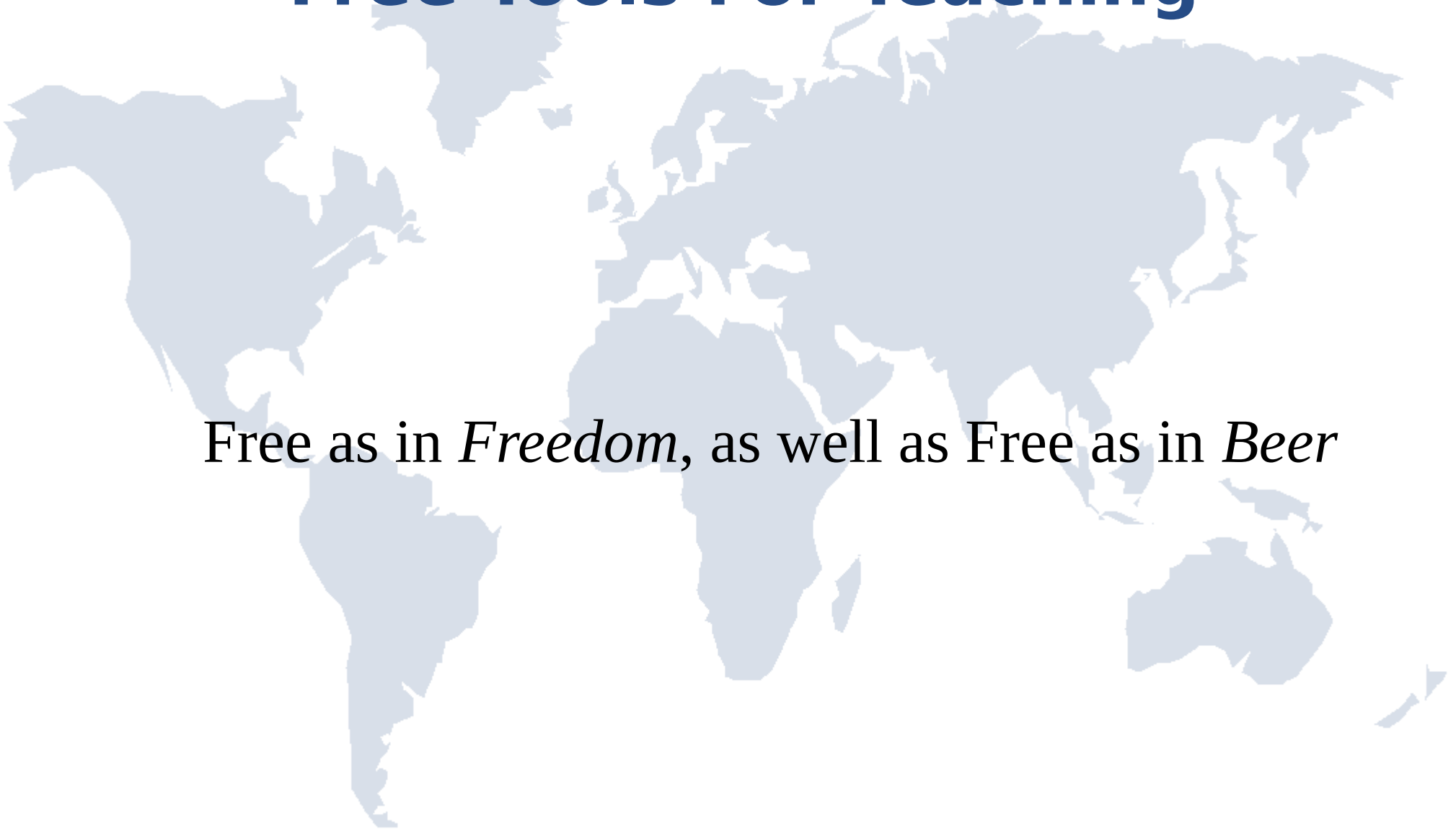
- Teach:
  - Fundamentals
    - How does computer really work?
      - Machine language
      - Cache
    - How do compilers, OS really work?
  - Comparison evaluation
    - Various office packages
  - How to share
- Do not teach:
  - Specific products

Things to Teach In New Education

- How to do distributed development
- How to license software
- How to develop formal standards
- How to write code to standards
- How to motivate software developers
- How to locate and engage the community of users and developers
- How to innovate, everywhere, always

How to evaluate and size customer needs

Free Tools For Teaching



Free as in *Freedom*, as well as Free as in *Beer*

LTSP – Linux Terminal Server Project

- Highly Available Server
  - All programs
  - All data
- Thin diskless clients for desktops
  - Easy to administer
  - Atlanta Public Schools
    - 4400 students, 2200 Clients, 233 classrooms 31 servers, 4 systems administrators

Curitiba, Brazil

High School that had “nothing”...

....except pride

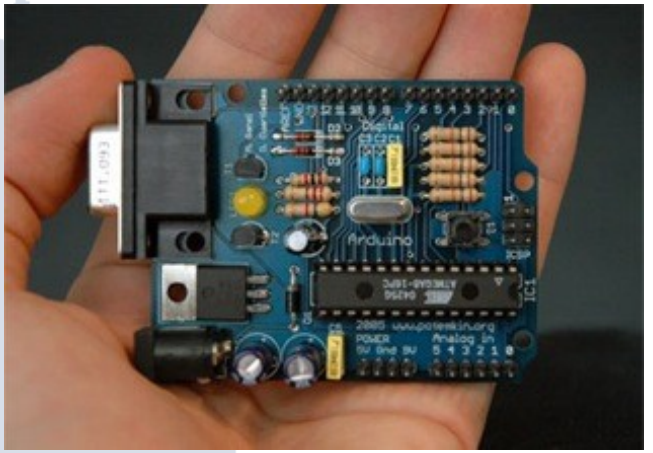
Bootable, Persistent Pen Drives

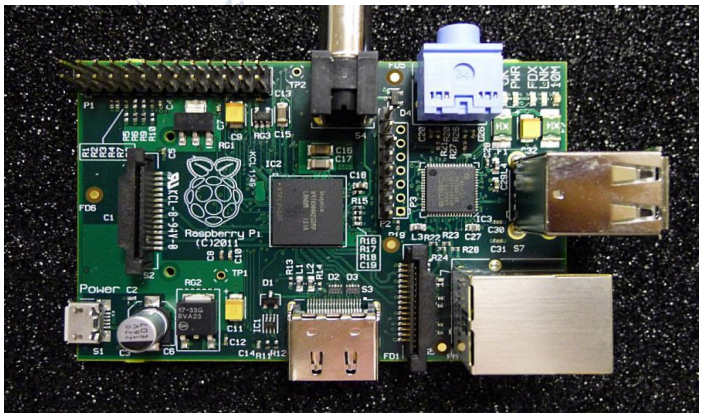
With your URL printed on the outside!

- A complete GNU/Linux Operating System on a Flash-based Pen Drive
- Persistent storage for the user
- Can be used with “any” desktop or notebook
- Student carries their data with them
- No licensing “worries”

More Than Just Software
Open Hardware

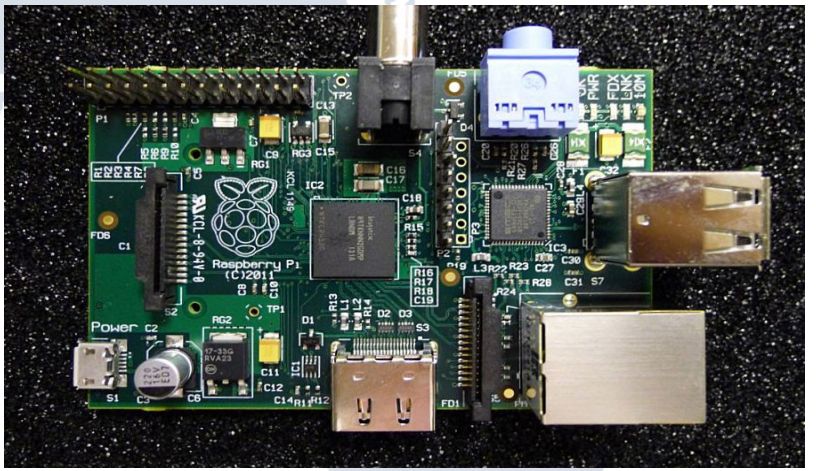
- Open Telephony
- Arduino
- Raspberry Pi
  - GNU/Linux for 35 USD



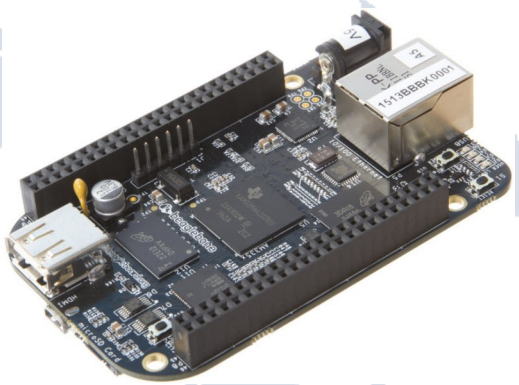


Raspberry Pi – 35 USD

- Single (now four) Core ARM – 700 (now 900) Mhz
- 500 Mbytes (now 1 Gbyte) RAM
- 3D GPU
  - Hardware video decode
- USB 2.0
  - 10/100 Ethernet
- HDMI
  - Analog AV also (gone and good riddance)
- GPIO Pins
- 3W

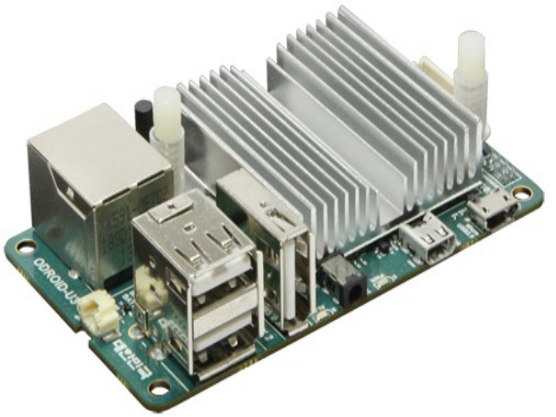


Many Little Computers: 45 USD – 199 USD

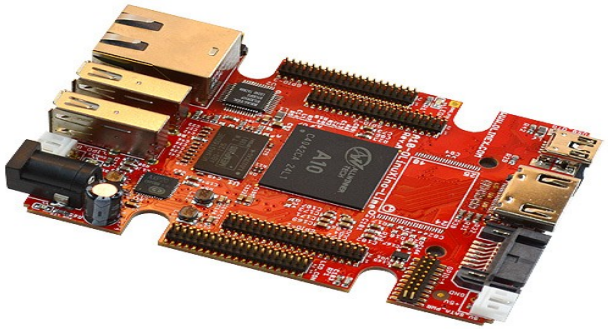


BeagleBoneBlack

Hackberry 10



ODROID-U3



OlimoX - LIME

Pandaboard

Galileo

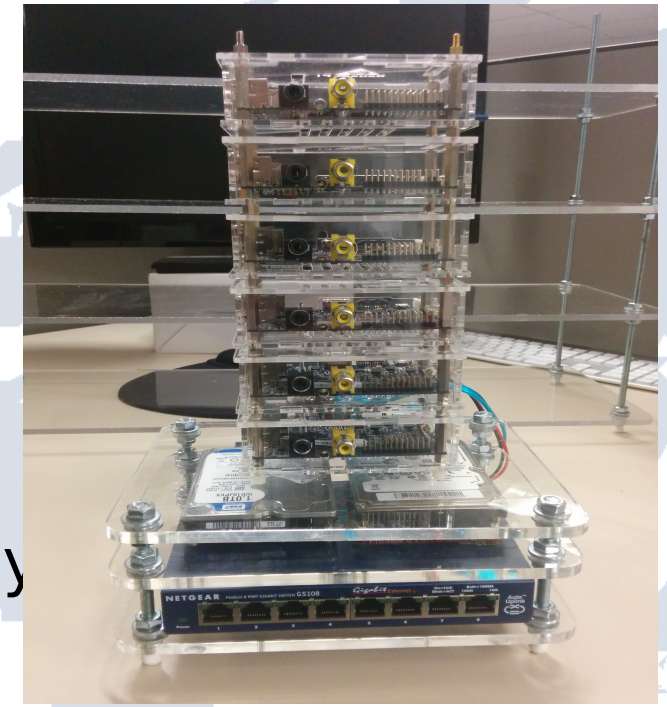
Adapteva's Parallella – 99 USD Supercomputer On A Card

- Two core ARM processor
- Field Programmable Gate Array
- Digital Signal Processing chips
- 16 or 64 core processor, each core having its own 32KB of memory directly addressable
- 5 W

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

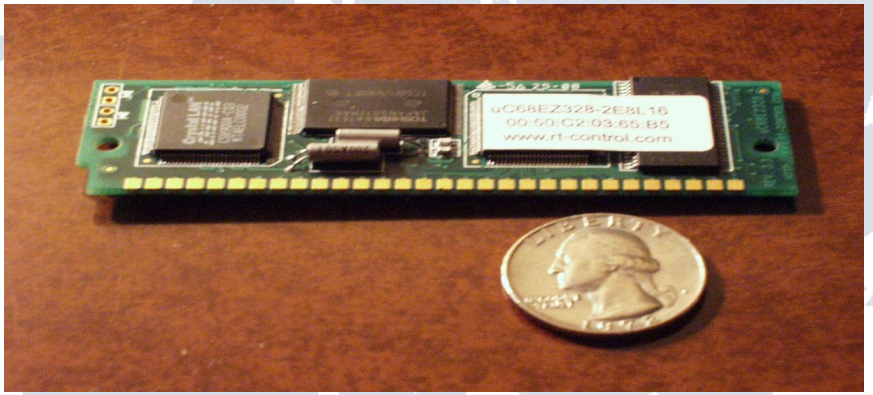


Why Is This Interesting?

- 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
  - Currently using “Banana Pi”
- Production cost: < 400 USD
  - Will use (4) new “Raspberry Pi 2 Model B”
  - Will increase from 12 to 20 ARMv7 cores

....Other Embedded Systems...

- Imagine students building products with these
- Imagine students designing these



IBM/Citizen Watch WatchPad

A Challenge for This Region

- Find your brightest students
- Get them to create a proposal for an embedded system products
- Choose best five proposals
- Get CS students to develop software on GNU/Linux systems
- Get EE students to develop controllers
- Get companies to manufacture products, create jobs

Creative Commons

A simple licensing model for:

- Text
  - Project Gutenberg – www.projectgutenberg.org
    - 39000 free books
    - Gateway to 100K
- Photographs
- Music
- Art

Today Even The Student Who Has No Money..

- Can find the college curriculum on the Internet
- Can find the objectives of the curriculum on the Internet
- Can find the information on the Internet
  - Khan Academy
  - MIT, Stanford, Rice
- Can learn the information from the Internet

If they have access to the Internet

More Than Just Software and Hardware: Open Processes

- Open (and well specified) Standards
  - www.openstandards.org
  - Can you read your MS Office V1.0 Documents?
- Linux Professional Institute
  - www.lpi.org

Paths For “Certification”

- Linux Professional Institute (LPI) – www.lpi.org
- Cooperative Education
- Guild Program
  - Apprentice
  - Journeyman
  - Master Craftsman
- Mentors
- Self-teaching - “Do not be afraid”

How To Develop A Portfolio

- Find a Free Software Project to Work On
- Start by reading the mailing list, getting used to the code
- Start by working on fixing bugs, matching the code style of others
- Eventually join the project as a developer
- Keep records of your contributions

How To Develop A Portfolio (Cont.)

- Ask for letters of recommendation from your project leaders and peers
  - And give praise where praise is due...
- Show your work to prospective employers

Mark Shuttleworth – developing Canonical

Closed Source Interns

Can show no real portfolio.....

...their contributions are hidden behind closed doors.

Closed Source for Research?

Your research might affect billions of people....
.....if they let you publish it....
...if they let you share it....

Other Nuggets

- No one buys computers or software
  - They buy solutions to problems
- “Open Source integrators and support people make more money than Microsoft integrators and support people” – Microsoft report

Summary

- Open Culture allows Open Education
  - Not just in computer science
  - Training can be found gratis
  - Guides to what to learn are available
- Certification (when needed) is available many ways.
- Open Culture gives best path for research

Questions?