Educating the Next Generation of FOSS Developers

What should they know?

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Right Now... Somewhere in America...
The Next Generations

2010  College
2014  High School
2018  Middle School
2021  Kindergarten
2025
FOSS & Education
“Open Source Sadly wasn't growing...”

Chris DiBona
“We were seeing the same people... a little older, a little fatter, a little grayer...”

Chris DiBona
Dump of assembler code for function main:

```
x000000000008f17c1 <main+0>:  push  %rbp
x000000000008f17c2 <main+1>:  mov   %rsp,%rbp
x000000000008f17c5 <main+4>:  push  %r12
x000000000008f17c7 <main+6>:  push  %rbx
x000000000008f17c8 <main+7>:  sub   $0x150,%rsp
x000000000008f17cf <main+14>: mov   %edi,-0x144(%rbp)
x000000000008f17d5 <main+20>: mov   %rsi,-0x150(%rbp)
x000000000008f17dc <main+27>: mov   0x1ada215(%rip),%rax  # 0x23cb9f8
x000000000008f17e3 <main+34>: add   $0x1,%rax
x000000000008f17e7 <main+38>: mov   %rax,0x1ada20a(%rip)  # 0x23cb9f8
x000000000008f17ee <main+45>: mov   $0x4000000000000000,%rax
x000000000008f17f8 <main+55>: mov   %rax,-0x38(%rbp)
x000000000008f17fc <main+59>: movl  $0x0,-0x14(%rbp)
x000000000008f1803 <main+66>: movl  $0x0,-0x18(%rbp)
x000000000008f180a <main+73>: lea   -0x110(%rbp),%rax
x000000000008f1811 <main+80>: mov   %rax,%rdi
x000000000008f1814 <main+83>: callq  0x90334e <vector>
x000000000008f1819 <main+88>: mov   0x1ada1e0(%rip),%rax  # 0x23c60a00
x000000000008f1820 <main+95>: add   $0x1,%rax
x000000000008f1824 <main+99>: mov   %rax,0x1ada1d5(%rip)  # 0x23c60aa0
x000000000008f182b <main+106>: callq  0x8f60e4 < Z13RegisterTestsV>
x000000000008f1830 <main+111>: mov   0x1ada1d1(%rip),%rax  # 0x23c60aa8
x000000000008f1837 <main+118>: add   $0x1,%rax
x000000000008f183b <main+122>: mov   %rax,0x1ada1c6(%rip)  # 0x23c60a88
x000000000008f1842 <main+129>: lea   -0x40(%rbp),%rax
x000000000008f1846 <main+133>: mov   %rax,%rdi
x000000000008f1849 <main+136>: callq  0x8effc8 < ZNSsC1Ev@plt>
x000000000008f184e <main+141>: cmpl  $0x1,-0x144(%rbp)
```
Finished Spiffy Products...
“Finished products are for decadent minds.”

Isaac Asimov
“The Foundation”
Freshman Year Laptop

Lenovo T410

http://www.rpi.edu/laptops/laptops10/specs10.html
Proprietary Candy

- Microsoft **Windows** 7 Enterprise
- Microsoft **Office** Professional 2010
- Microsoft **Visual Studio** 2010
- Maplesoft **Maple** symbolic algebra program
- MathWorks **MATLAB**
- National Instruments **LabVIEW**
- Siemens **NX CAD** package
- **MapInfo** Professional
- Bentley Microstation
- Adobe Digital Collection (**Photoshop** and **Acrobat** Professional)
- Symantec anti-virus software suite

http://www.rpi.edu/laptops/laptops10/specs10.html
Proprietary Candy

- MIT
  http://ist.mit.edu/services/software/vsls

- Caltech
  http://imss.caltech.edu/cms.php?op=wiki&wiki_op=view&id=19

- Cornell
  http://cusoftware.cornell.edu/cusoftware/purchase/index.cfm

- Stanford
  https://itservices.stanford.edu/service/ess

- UC Berkeley
  http://software-central.berkeley.edu/

- CMU
  http://www.cmu.edu/computing/software/all/index.html
Proprietary Candy

- JHU
  http://www.sais-jhu.edu/it/students/hopkins-it-programs.htm
- UCSC
  http://its.ucsc.edu/service_catalog/software_licensing/
- College of Charleston
  http://www.cs.cofc.edu/software.php
The Walled Garden...
The Walled Garden...

- You can use this all this software, but ...
- Only from inside Rensselaer network
- Reverse Engineering is **Forbidden** !!
- Once your four years finish.... you learn the real price
In the absence of FOSS...
12 Things that They will NOT Know

- The Difference between Compiling, Archiving and Linking
- The Command Line
- Memory Allocation
- Code Coverage
- Memory Leaks
- Sockets
- Revision control (CVS / SVN / Git)
- Drivers
- Reverse engineering file formats
- Management of large software systems (> 1000 LOC)
- Debugging past the system barriers
- Shell Scripting
With FOSS...
Take it apart...
Only then you will reach Enlightenment…
1) The financial interests of students must be taken into account when we propose curriculum modifications.

2) The benefits / drawbacks of every approach should be based on experimental evidence that must be verifiable by third parties.
1) Using proprietary tools do not necessarily prevent students from learning specifics of "how things work".

2) In some cases open source tools are better aligned with the financial interests of students.
Rensselaer
Rensselaer Center for Open Source Software
Sean O'Sullivan, Alumnus and Entrepreneur, Donates $2 Million To Rensselaer To Create Center for Open Software
up to 100 Rensselaer students annually are given stipends to develop software and content

http://rcos.rpi.edu/donor.html
• ~ 30 students per semester
• Strictly for under-grads
• Particular focus on freshmen
• ~20 projects per semester
• Peer-to-peer interactions
• Web applications
• Hardware projects
• Kernel Level
• Educational Software
• Phone Applications
- Digital Signage (Concerto)
- Seed (Gnome – javascript apps)
- iPhone Open Source Library
- Rensselaer Online Course Scheduling
• RPI – ACM
• UPE – CS Honor Society
• RPI – Linux Users Group
Open Source Software Practices Course
- 2007
- 2008
- 2009
OpenCourseWare

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  http://creativecommons.org/licenses/by/3.0/

- You are free to Reuse
- You are free to Remix
- As long as you credit the author
Syllabus

- Economics (3 lectures)
- Intellectual Monopolies (2 lectures)
- Software Patents (1 lecture)
- Open Source Licensing (2 lectures)
- Case Studies (Cmake / VTK / GNome / KDE...) (5 lectures)
- Business Models (1 lecture)
- Software Development Process (1 lecture)
- Open Access Publishing (1 lecture)
- Wikipedia & peer production (1 lecture)
- Hands-On Exercises (gcc / kernel / sockets)

http://public.kitware.com/OpenSourceSoftwarePractice/index.php/Fall2009/Course_notes
FOSS Curriculum

- Intellectual Monopolies
- Economics
- Licensing
- Social Implications
- Community of Practice
Economics
Scarce Goods...
Free Market...
Market Failure...
Monopolies and their Evils...
Software Patents...
FOSS Licensing...
Case Studies...
Wikipedia & Peer-production...
Business Models...
GCC...
Kernel...
Sockets...

Hands-On Hacking...
Observations...
Teaching a FOSS Course

- Diverse level of student skills (Power distribution)
- Students have been trained **NOT** to copy from each other...
- Teaching Freedom without Coercion...
Students are used to Structure

- Tell me about my grades
- What's my homework?
- Will this be in the test?
- How do I do well in this course
- How much is enough?
Replicating an FOSS community inside a classroom

- Asking people to take Initiative?
- Controlled chaos?
- Personality clashes
- The long tail: how to grade small efforts?
- Triggering emergence of self-organization
- Motivating people
- Meritocracy
Finding a FOSS project to work on

- Social aspects (a lot of FOSS is not about Technology...)
- Joining a community can be tricky
- Not all communities are prepared to accept newcomers
- Small contributions vs Large contributions
- Easier to start a project from scratch than to join an existing project.
What are we missing?
Credits...
Credits: Creative Commons Images

- Classroom: http://www.flickr.com/photos/velkr0/3472576304/sizes/l/
- Barbed Wire: http://www.flickr.com/photos/lwr/278407588/sizes/l/
- Rusted Barbed Wire: http://www.flickr.com/photos/pietroizzo/1799291386/
- Rensselaer: http://commons.wikimedia.org/wiki/File:'86_Field_RPI.JPEG
- Money http://www.flickr.com/photos/amagill/3366720659
Credits: Creative Commons Images

- Highway
  http://en.wikipedia.org/wiki/File:S1_1.JPG
- Fence
- Ghost – Catrina
- Car Hood Open
  http://www.flickr.com/photos/goldberg/882979234/
- Car Engine
  http://www.flickr.com/photos/whiskymac/2787883406/
- Walled Garden
  http://www.flickr.com/photos/ianashdown/3657006174/
- Monopoly
  http://www.flickr.com/photos/harshlight/3236314738/
Credits: Creative Commons Images

- Big Box Store
  http://www.flickr.com/photos/nateone/3242712966/

- Car modified
  http://www.flickr.com/photos/racecarphotos/2311559516/

- Hands on Keyboard
  http://www.flickr.com/photos/striatic/1629254/

- Business Models
  http://www.flickr.com/photos/worldeconomicforum/2894851944/