

# Free Software and its Manifestations

K. Gopinath

Indian Institute of Science

# A Related Idea

- Knowledge has to be free
- Knowledge does not decrease when shared!

*subhashita:*

- ``Cannot be snatched away by a thief,  
cannot be snatched away by a king,
- cannot be divided among brothers,  
not heavy either.
- If spent daily, it always keeps growing.
- The wealth of knowledge is the most precious of all."
- Paper and Printing made copies easier post 15<sup>th</sup> century
- Knowledge in mathematics, natural sciences free for all!
  - India's past contributions in mathematics, grammar, ...

# What is Free Software?

- It is an idea of how deliverability of software should be framed so that complete control rests in the hands of the end user
- So the source of the software is needed!
  - Good for academics!
- It can be shared also with others!
- Richard Stallman's “The four freedoms”
  - Run sw, study/change sw, distr sw
  - Distr changed versions
- Last 15 years or so: free software **good for industry too!**

# Operating Systems Success Story!

- GNU/Linux
- BSD family
- OpenSolaris
- “The adoption of free software to ***resolve incompatibility*** between the **economic need for provider diversity** and the **engineering need to avoid product diversity** is fairly unique across all industry. It is not a coincidence that the most important and successful free software is the system software such as the operating system kernel and middleware such as low-level software libraries, many system tools, compiler tool chain, X server, windowing systems, GUI toolkits, web, email and other services, databases, and even a dot-net workalike” Slightly rephrased from Andrew Morton (a key developer for Linux kernel), OLS 2004

# The Power of Openness!

- Paul McKenney and Dipankar Sharma (IBM) '07
  - Closely involved in the development of the RCUupdate feature in the Linux kernel
- Their understanding of this feature and its interactions with the rest of the kernel deepened more in the few years (5) it was in the Linux kernel than the 15+ years it existed in a commercial operating system where it originated first.
- This happened due to the diversity of uses the basic mechanism was subjected to and tested against by completely unknown developers across the globe.
- *Similar to the scientific system of enquiry (attempt “falsification” of theories)! A success story of the last few centuries.*

# Other examples

- Java language and libraries
- Google's Android mobile: the full stack
- All new research ideas typically start out as free software nowadays
  - Yahoo!'s Hadoop, Zoo, ...
  - Biological genetic sequence modelling: Muscle (for alignment of sequences), HMMER (for studying genetic sequences), ...
  - Climate change studies: eg: GISS 3-D general circulation models (GCMs) and coupled atmosphere-ocean models for simulating Earth's climate system
- Almost all socially committed programs
  - Medical records: OpenMRS; disaster mgmt: Sahana

# Technical Ideas Also Need to be Free!

- Patent System developed so that an invention becomes accessible to society
  - Inventor has right to exploit it exclusively for a fixed period
  - But inventor has to disclose in sufficient detail so that a competent person can duplicate it after exclusive period
  - Works well for most technical areas that deal with material goods rather than abstract ideas
- But not for software!
  - If non-obvious, software often based on (deep) mathematics that is free as per the patent system
  - Also an engineering product that often encodes “simple” or obvious processes in technical or business processes

# Patent System

- Breaks down for software
- Often has given patents for obvious ideas
- “Software Patents” use a strategem of embodying abstract ideas in physical devices for patentability
- Indian patent system luckily still does not allow such strategems but many attempts to make it close to the US system that allows software patents
- Data=code in CS => software patents tread on copyright system, more confusion!



# Hardware, Protocols also Want to be Free!

- LinuxBIOS, OpenFirmware, OpenSPARC
- Internet protocols open for all from the start!
  - Most successful set of protocols across the globe
  - Most Internet software free!
- When protocols or interfaces not open (proprietary)  
=> failure typically!
  - eg. many proprietary GIS systems but “islands” typically
  - eg. Indic computing/e-gov: too many non-open solutions
  - Only market dominance prevents failure but a competitive marketplace does not allow this for too long a period!
- Cloud Computing Needs to Become Free!
  - Too little control (sw/data) in the hands of user

# Other related ideas

- Open Access Publishing
  - eg. PLoS Biology, BioMed Central
  - 10-15% of the 20–25,000 peer-reviewed journals
- Open Publishing (Wikipedia, Wikis)
- Creative Commons
  - content creators take control of how they choose to share with others
- Right to Information
  - Governmental processes or documents should be freer!
  - In India from 2005, US '67

# Major Indian Issues

- Free software in Indian educational system
- Free software for Indic computing
- Free software in E-Governance
- Free software for Geospatial Analysis
- Free Software in Accessibility Computing
- Free software in Mobile devices
- Free Software Business Models
- Open Standards
- Free software in UID Project?
  - Proprietary technologies???

# A Small Example of Free Software Synergy

- IIT Madras developed Acharya system for Indian Languages
  - A Qt based application
  - Better than UNICODE encoding
    - Current snippets or texts on Internet often wrong!
  - Makes sorting, search and other operations simpler
- IISc here has taken this software and made it run on S60-based mobiles (Nokia, some Sony Ericsson). Demos by Anand the developer
- Plans to use this Indic software in OpenMRS, etc for storing health records on mobiles

# Free Software Needed Now More Than Ever?

- Major Environmental issues of the 21<sup>st</sup> century such as pollution, climate change!
- Complex systems have many interdependent parts with no one (individual or a company) having a complete picture
  - Any software handles only a small part
- If proprietary, only the two owners can put two diff programs to work together or standards needed
  - Economic incentive needed (+ time, staff)
- If free sw, source avlbl. May be possible to put them together by anyone! Scalable model!

# Global Warming

- Due to Solar flares?
- Due to CO<sub>2</sub>?
  - Industry, transportation, respiration/forest cover, microorganisms in oceans and on land, ...
- Due to Methane?
  - Cows, agriculture, permafrost, ...
- Affected by and Effects
  - Atmosphere, clouds/rainfall, ocean currents, geophysical processes, glaciers, coastal cities
  - Biodiversity: Corals, “good” and “bad” microorganisms, productivity of agriculture

# Climate Change Software

Need (for example)

- numerical methods, compilers, data ontologies, visualization software, embedded systems software, as well as
- coordination across Internet using wikis, Wikipedia, social media, reputation systems, etc

Need transparency and effective flow of information between scientists, and between scientists and society so that effective action can be taken.

***Free software is a necessary lubricant in this process as software embodies the executable version of the models.***

# India Energy Situation

- GRIM!
- Only coal avlbl in plenty
  - Nuclear power will take time
  - Oil supply: no reliable longterm partners
  - Heavy competition from China that has succeeded in cornering deals and winning them against India
- Clean coal technologies needed by India
  - SOFTWARE NEEDED!
    - Advanced algorithms, new techniques
  - Can this software be developed as research projects by students and faculty?
  - Can this be done as free software so that easier to work together?



# Another Major Future Issue

- Mobiles more affordable than PCs
- Free software based mobile systems!
- Mobiles for distributed coordination
  - eg. study groundwater depletion, pollution, epidemiology, traffic congestion, health monitoring, etc
  - Reduce energy usage, pollution
- Need incentives for truthful pooling of data collected by cheap sensors (“mobiles”!)
  - Lots of brand new software has to be written!
- Start a movement on Open Hardware for mobiles and Free Software on such hardware?

# Conclusion

- Free Software has significant momentum
- Has the potential to further open up society
  - But a proper incentive system needed for deeper gains and to solve continental scale problems
  - Just like the “copyleft” mechanism in GPL to avoid freeriders!
- Students, Teachers, Activists, Reporters, Developers, Industry support, Free software businesses and models **all needed!**