Linux for Education

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It was a pleasant surprise to browse through the entire list of top 500 highest performing supercomputers of the world, a list released by the International Supercomputing Conference (ISC) 2016 in June, 2016 followed by TOP500 list released in November, 2016 (this being the latest so far), to find that all the world top supercomputers use Linux as their operating system. A couple of interesting facts from the list is worth mentioning here: Both China and USA have claimed to possess 171 super computers each. However, the top two slots are occupied by China followed by next three slots by USA, followed by Japan. The top supercomputer today is Sunway TaihuLight having 93 Petaflops per second computing power with 10649600 cores! The fastest Indian machine, CRAY XC40 at IISc Bengaluru stands at 133rd position with 0.9 Petaflops per second and 31104 cores. India has only five entries in this list. There are in all only 29 counties having the top 500 super computers.

I have been always wondering which operating system should be tough to our students right from early ages and why: Microsoft, Linux, Apple Mac OS? If one samples the syllabus of CBSE, SEBA, ICSC, one would find that these are heavily loaded in favour of Microsoft; in so much so that all prescribed text books are based on Microsoft. This simply means that we in India do not teach our children the most powerful computer operating system. The situation is much worse when you delve deep into the computer labs of higher centres of learning, our colleges and engineering institutes including top institutes in the country. Most of all not only run on Microsoft, but also harbour unlicensed pirated software of all kinds. It makes me feel that somewhere computer teaching is not at all ethical in the country, and to this the top management of the educational institutions, decisions makers including political leadership are virtually blind. This what I call Garbage In Garbage Out (GIGO), and no wonder India definitely lags behind in the Linux movement. In India we consciously do not promote learning of Linux (how can we displease the big brother MS?) in schools and colleges.

How do we decide our operating system purchases? We are definitely not guided by the Super computers of the world. We are guided by flashy icons and external appearance, none of which are essential for fast and power computing. We are also guided by our instinct to be invariably "horrible typists", and therefore, we focus on office productivity suites, others think of "photoshop", or "pagemaker" or "autocad" or even "matlab"… Reasons are many, but the choice is one: Microsoft. In this process we do not realize two things: firstly that there are equal or better systems and software options available on Linux, and secondly that most of these software codes do not respect the four freedoms (*Freedom 0: The freedom to run the program as you wish, for any purpose; Freedom 1: The freedom to study how the program works, and change it so it does your computing as you wish; Freedom 2: The freedom to redistribute copies of the original code; Freedom 3: The freedom to distribute copies of your modified versions to others*). How do these freedoms and choices impact learning in educational institutions? If a student has no access to the source code, he becomes a mere "dummy" user who is most likely to develop dependence upon the software and may not be able to unlearn in future. Therefore, by promoting commercial software in educational institutions, we are only manufacturing "IT Coolies", who have no understanding of how the software or system works. By promoting commercial software (in Government institutions at public cost) we are only creating committed customer base for these software companies, at a time when the student would have done well to study an equivalent free software and develop a deep understanding of the underlying principles.

Look at Linux, a very powerful operating system and available for gratis, and yet we are hesitant to adopt it in our educational system. The Government of Assam has been giving, since 2005, Anundoram Borooah Award, a gift of computer laptop to every student who secures 60% or higher marks in class 10th Board examination. Barring 2015, all years it has been Linux OS. People have often asked me "Why do you deprive the students from best computers by denying to load Microsoft in these computers when the Government can very well afford that much money". My answer has always been "Why give students anything third rate when the best of the best and most powerful operating system is being loaded and that also at no cost?". Anundoram Borooah laptops are power packed. If any one were to buy that much of proprietary software, one would have to spend not less that a million dollars per laptop.

Look at the array of software in the Anundoram Borooah Award laptops: LibreOffice 5.2, GIMP,Inkscape,Scribus etc. These being on the Graphical User Interface (GUI) based application side. Below is a list of some of the applications available under Linux vis-a-vis Microsoft.

Windows apps	Linux apps	Description
Microsoft Office	Libre Office	Office package
Visio	Kivio, yed	Diagramming
Microsoft Project Manager	Imendio Planner, Kplato, MOOS Project Viewer, MrProject	Project management
7-Zip, Winzip, Winrar	Karchiver, File Roller, ark, hjsplit; *command line tools*	Archivers
chkdsk	fsck	check your file system (and the hard disk beneath it) for errors
Daemon Tools	mount, GMount-ISO	ISO mounting
Quark, Quark Express, Microsoft Publisher	Scribus	DTP software
Adobe Acrobat PDF Reader	Adobe Acrobat Reader, Xpdf, Kpdf, Ghostview, Evince; *more*	PDF readers
Adobe Acrobat Distiller, PDFCreator	CUPS-PDF, OpenOffice.org, kprinter -- can convert to pdf. *more*	PDF authoring
Adobe Acrobat PDF editor	pdftk, pdfedit, pdfjam, pdf studio, *more*	PDF editing tools
Microsoft Internet Explorer, Firefox, Netscape, Opera, Chrome, Lynx, etc.	Firefox, Konqueror, Chrome, Opera	Web Browsers

Windows apps	Linux apps	Description
Outlook Express, Outlook, Thunderbird, Pegasus, Lotus Notes	Kontact, Evolution, Thunderbird	Email clients.
ICQ, MSN Messenger, AIM (AOL Instant Messenger), Trillian, Pidgin	PidgIn, Kopete, aMSN, Emesene (MSN), Centericq	Instant messaging software.
Microsoft HyperTerminal	minicom	
FileZilla FTP Client, WS FTP, Bullet Proof FTP, CuteFTP	FileZilla FTP Client, KFTP (KFTPGrabber), Kasablanca, FireFTP, Konqueror, KBear, CrossFTP, Nautilus	FTP clients. Note that dedicated FTP clients are rarely needed on Linux, since the default file manager can usually browse FTP shares. Several GNOME programs can directly open and edit files on FTP, SFTP and WebDAV shares.
mIRC	Konversation, Quassel, KVIrc, XChat, PidgIn, BitchX	IRC Clients
UltraVNC, TightVNC, RealVNC, Remote Desktop	TightVNC, RealVNC, rdesktop, FreeNX, x11vnc, Synergy, XDMCP, SSH with X11 forwarding (-X or -Y option)	Desktop Sharing
Adobe Photoshop,Corel Photo-Paint,	GIMP, GIMPShop, Krita, Pixel (non-free high quality), LightZone (non-free high quality)	Raster graphics editors
Corel Draw, Adobe Illustrator	Inkscape	Vector graphics editors
Irfanview, ACDSee	XnView, GQView, Mirage, GThumb	Image viewers
3D Studio MAX, Blender, Maya	Blender, Maya, Softimage, K-3D	3D modeling software
Autodesk Inventor, Solidworks, CATIA	FreeCAD, SALOME platform	Professional 3D CAD software
Windows Media Player, PowerDVD	MPlayer, Xine, Totem, Kaffeine, VLC	Video Players
Winamp, Sonique, iTunes, aTunes	amaroK, aTunes, XMMS, noatun, RhythmBox, xine will play aac and	Music Players

Windows apps	Linux apps	Description
	wma, Banshee	
Windows Movie Maker, Adobe Premiere Elements,Multiquence	Cinelerra (difficult but very professional), KDenlive (easy and powerful), Blender, LiVES, Kino, AviDemux	Video Editors
	KTouch	Touch typing tutors
Maple, Mathematica	Maple, Mathematica, Maxima	Computer algebra systems
Matlab	Matlab, Octave, SciLab, Sage, KAlgebra	High level numeric computation environments
SPSS, Stata, EViews	R-project, Stata, PSPP, S-Plus, Gretl	Statistical analysis

The Command Line Terminal or Command Line Interface (CLI) application stack is so rich with: C/C++ compiler and debugger, mysql database, BC calculator, ImageMagic software suite to create, edit, compose, or convert images and graphics in over 200 formats to mention a few. Each one them is a great learning tool and powerful in application. There would not be enough space to write about even one of them in some detail. I would, however, attempt to show a few applications that I myself use very frequently on the command line.

BC: BC stands for basic calculator, buts its actually a full fledged arbitrary precision language. This is the most frequently used program on the CLI by me, as its the best calculator, you can quickly program to make a function on the fly, can easily play with variables and values, and the best part is that you do not have to bother about the number of decimal precision that you are looking for- could be 0 or even more than 5000, it all depends how powerful your computer is. You control the number of decimal places by setting the scale to any desired value you wish (if you enter any -ve number, it sets scale to 0!). Go to the terminal and invoke bc by typing bc -l (this option to load math library):

lenovo@lenovo-ThinkPad-X250:~$ bc -l
bc 1.06.95
Copyright 1991-1994, 1997, 1998, 2000, 2004, 2006 Free Software Foundation, Inc.
This is free software with ABSOLUTELY NO WARRANTY.
For details type `warranty'.

You can play with the decimal now as shown below:

scale=10
22/7
3.1428571428
scale=250
22/7

3.1428571428571428571428571428571428571428571428571428571428571428571\
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If you ever wondered how to compute value of pi (π) to any desired value. BC makes your job simple. It does so simply by taking 4 times arctan of 1 (which is 45^0 or $\frac{\pi}{4}$). Therefore, you can experiment with the value of π in BC as shown below (a stands for arctan):

scale=10
4*a(1)
3.1415926532
scale=250
4*a(1)
3.141592653589793238462643383279502884197169399375105820974944592307\
81640628620899862803482534211706798214808651328230664709384460955058\
22317253594081284811174502841027019385211055596446229489549303819644\
2881097566593344612847564823378678316527120190888

Now you can see why $\frac{22}{7} \neq \pi$.

There is a lot more to BC that what I could show in a few lines above. If you want to compare two computers and find out which one is more powerful, just execute this command in the terminal window (you can vary scale value to higher values also if you are confident of the compute power!):

time echo "scale=5000; 4*a(1)" | bc -l

To execute this command, my laptop took 23.8 seconds. When I increased the scale to 7500, it took 1 m 7.400 s. Here is a graph that I produced of the compute power of my laptop using the command above. The graph is generated in LibreOffice Calc 5.2. I also did the best fit of time vs decimal places as Power trend line as well. The best fit equation with coefficient of determination is also given in the chart itself.

Compute Power of Laptop

$f(x) = 7.40863527353087E\text{-}009\ x^{2.5715952464}$
$R^2 = 0.9998756278$
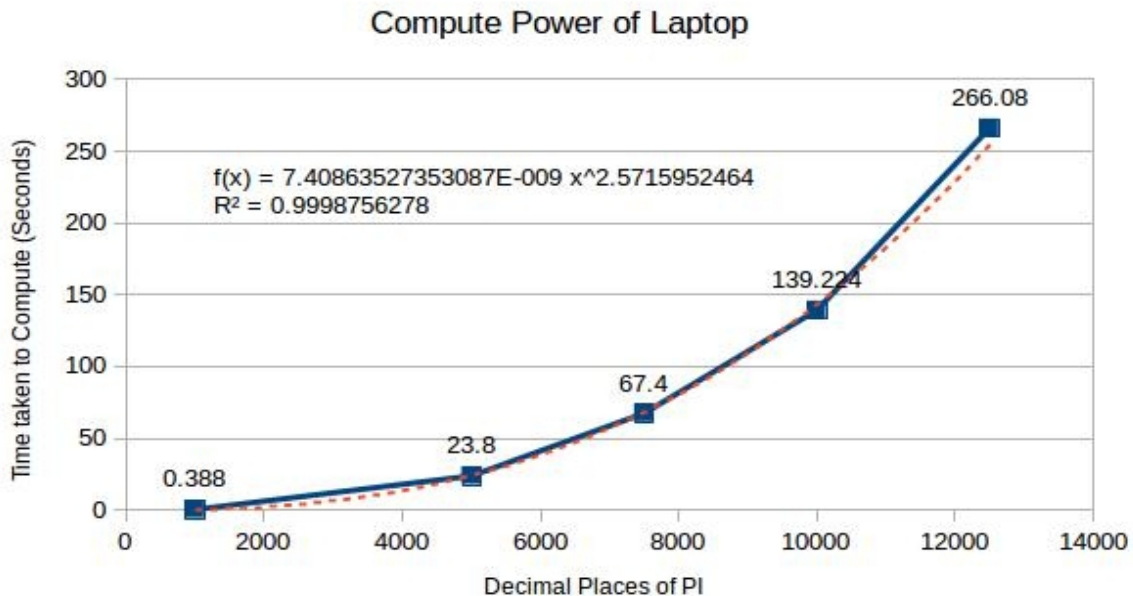
The equation shows that my laptop would take about 15 hours to compute upto 1 lakh places, and about 38 days to compute upto 5 lakh decimal places.

I have also tried to show at the same time glimpses of LibreOffice, a free office productivity suite from The Document Foundation (a fork of OpenOffice.Org). The best part of LibreOffice is the computation power of "Table" feature in Writer (its almost like a spreadsheet), ability to handle large documents (I have created single document files of more than 500 pages without any trouble), handling auto styles and numbering (of paragraphs), and best is the "Math" feature of LibreOffice which I shall just demonstrate here.

LibreOffice Math: I have already demonstrated a few features of LibreOffice in the previous section while talking of BC. Lets show here how the students and teachers can take advantage of the Math Formula feature of the LibreOffice. Here are a couple of equations:

Integration: $\int_{a_0}^{b_i} f(x)\,dx = \lim_{x \to \infty} \sum_{i=0}^{n} f(x_i^h)\Delta x$ and the code to produce this is

```
int from a_0 to  b_i f(x)dx=lim csub {x toward infinity} sum from i=0 to n
f( x sub i sup h ) %DELTA x
```

Here is another equation: $\oint B.dS = -\int \frac{\partial B}{\partial t}.dS$ and the code to produce this is

```
lint B.dS = -int {{partial B} over {partial t}}.dS
```

An example from Ring Theory: $n.1 = \underbrace{1+1+1+...+1}_{n} = 0$ code:

```
n.1 =  {1+1+1+...+1} underbrace {n} = 0
```

Therefore, you can see that LibreOffice is a power-packed office productivity suite with many features, most of which are beyond the scope of this small writeup. Its well documented guides/manuals are available online and freely downloadable.

Road Ahead: This article should not be taken as a Linux guide at all. Its a small attempt to put before the esteemed readers a point of view opting for the best operating system and the best office suite. The student and the teaching community needs to imbibe principles of free software and undertake journeys on the discovery path of discerning virtues of Linux which are manifold. There are free software for kids who would just be learning to dabble with mouse and keyboard to serious students who want to delve deep into the mysteries of atoms, molecules and laws of nature or those who just want to be cool and chill with great animation and graphics. Or you could be just like *Wrishiraj Kaushik,* founder of Super X OS, trying to figure out the next generation operating system that would change the world! Possibilities with Linux are immense. Pick up a GNU/Linux PC or laptop and start exploring right away.