Linux Tutorial and Introduction
Part 1. Basics

NNSA Computational Workshop

@ Nashville, TN

Goals

- The goal of this tutorial is to
  - provide enough Linux background, history and its development
  - Provide hands-on training basics of using Linux via the command line.
- Suitable audience are
  - who have no or little previous experience with Unix-like systems, or
  - who know a few commands but would like to know more.

What We Will Talk

- What is an OS
- History of Linux
- Other Operating Systems before Linux
- Linux & GNU
  - Open Source & Free
- Advantages and Disadvantages of GNU/Linux

What is an OS

- The operating system (OS) is the program which starts up when you turn on your computer and runs underneath all other programs - without it nothing would happen at all.
  - In simple terms, an operating system is a manager. It manages all the available resources on a computer, from the CPU, to memory, to hard disk accesses.

Tasks the OS must perform

- Control Hardware - The operating system controls all the parts of the computer and attempts to get everything working together.
- Run Applications - Another job the OS does is run application software. This would include word processors, web browsers, games, etc...
- Manage Data and Files - The OS makes it easy for you to organize your computer. Through the OS you are able to do a number of things to data, including copy, move, delete, and rename it. This makes it much easier to find and organize what you have.

Before Linux

- 1960, Early stage of computation
- Mainframes are the “computers”
- Innovating idea: Multi-programming & Multi-user
  - Create a multi-user & multi-program OS
- 1964, Multics
  - Multiplexed Information and Computing Service
  - GE, MIT and AT&T
  - Standard Operating System for USA government

Before Linux: UNIX

- ❑ Many difficulties in Multics development
- ❑ 1969
  - ❑ AT&T pulled out of Multics
  - ❑ Ken Thompson (Bell Labs)
    - ➢ A simplified version of Multics → UNIX
  - ❑ Dennis Ritchie
    - ➢ Rewrite the UNIX in C
- ❑ AT&T cannot sell the UNIX
  - ❑ UNIX is the first free Operating System

Before Linux: BSD

- ❑ 1974
  - ❑ Berkeley University buy a tape of UNIX
  - ❑ Student start code navigation
  - ❑ UNIX is customized and improved
  - ❑ They call the OS as BSD (Berkeley Software Distribution)
- ❑ Now
  - ❑ BSD does NOT contain any code of AT&T
  - ❑ BSD 4.4, FreeBDS, NetBSD and OpenBSD

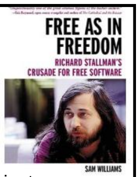
Before Linux: Commercial UNIX

- ❑ 1983, AT&T is splitted → It can sell software
- ❑ There is a great market for Operating System
  - ❑ Major hardware vendors need OS
- ❑ AT&T is selling UNIX System v4 and licensing it
  - ❑ AIX for IBM, HP-UX for HP, …
- ❑ BSD is a real danger for AT&T's market
  - ❑ BSD is not supported
  - ❑ BSD should not be used in commercial

End of UNIX

- ❑ AT&T sold UNIX as much as possible
  - ❑ Novel bought UNIX code and License
- ❑ Novel sold the code and license after 2 years
  - ❑ Santa Cruz Operating System
- ❑ Microsoft developed Xenix
  - ❑ Based on UNIX VIII
  - ❑ It was NOT successful

Before Linux: Hurd



- ❑ 1983, GNU project was started by Richard Stallman
  - ❑ software should be free from restrictions against copying or modification in order to make better and efficient computer programs
  - ❑ Companies make their money by maintaining and distributing the software, e.g. optimally packaging the software with different tools (Redhat, Slackware, Mandrake, SuSE, etc)
- ❑ Stallman built the first free GNU C Compiler in 1991. But still, an OS was yet to be developed

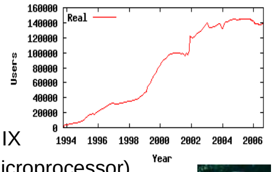
Before Linux: Minix

- ❑ Tanenbaum developed free OS
- ❑ Its name is Minix
- ❑ Minix is based on UNIX
- ❑ Source code available, Modification is restricted
- ❑ It cannot run on 32bit processors

Staring Linux

- ❑ Develop a free OS for 32bit (Intel) processors
  - ❑ Title of a Finnish student's MS thesis
- ❑ The student is Linus Benedict Torvalds

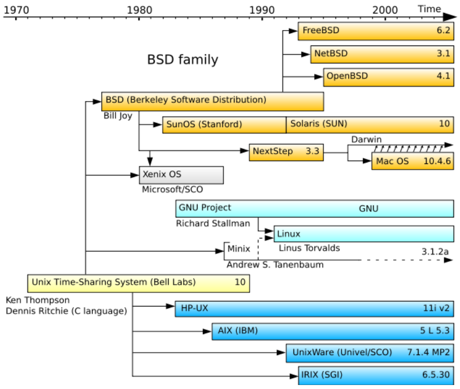
Linux was Born



- ❑ Birthday
  - ❑ 25 August 1991
  - ❑ Linux 0.01
  - ❑ It was developed in MINIX
  - ❑ It run on 80386 (32bit microprocessor)
  - ❑ It had a terminal emulator & C compiler
- ❑ Linus posted the code to Minix mailing list
  - ❑ At the end of 1992 there were about a hundred users

Now, Linux kernel

- ❑ More than 290 Mbytes source code
- ❑ More than 500 Maintainers
- ❑ More than 20 Supported Architectures
  - ❑ i386, ia64, Alpha, Arm, PowerPC, …
- ❑ More than 20 Network Protocols
  - ❑ IPv4, IPv6, ICMP, ICMPv6, TCP, UDP, 802, ..
- ❑ More than 50 Device Driver Categories
  - ❑ HDD, PCI, Network, SPI, I2C, USB, …



1970 1980 1990 2000 Time

BSD family

FreeBSD 6.2

NetBSD 3.1

OpenBSD 4.1

BSD (Berkeley Software Distribution)

Bill Joy

SunOS (Stanford)

Solaris (SUN) 10

Darwin

NextStep 3.3

Mac OS 10.4.6

Xenix OS

Microsoft/SCO

GNU Project GNU

Richard Stallman

Linux

Linus Torvalds

Minix

3.1.2a

Andrew S. Tanenbaum

Unix Time-Sharing System (Bell Labs) 10

Ken Thompson
Dennis Ritchie (C language)

HP-UX 11i v2

AIX (IBM) 5 L 5.3

UnixWare (Univel/SCO) 7.1.4 MP2

IRIX (SGI) 6.5.30

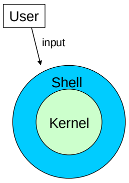
- ❑ http://www.levenez.com/unix/unix_letter.pdf

Mr. TUX

- ❑ TUX is the official mascot of the Linux
- ❑ TUX: Torvalds UniX
- ❑ 1996
  - ❑ Alan Cox suggest
  - ❑ Larry Ewing create it
- ❑ He lost all Linux logo competitions

Linux is an OS Kernel

- ❑ What is OS Kernel?
  - ❑ Kernel is the government of computer
  - ❑ Kernel abstracts the hardware
  - ❑ Kernel controls the system resources
  - ❑ A kernel by itself gets you nowhere
- ❑ In addition to kernel, you need
  - ❑ Shell, (Graphic) User Interface, …
  - ❑ Library and programming tools
  - ❑ Applications and utilities



User

input

Shell

Kernel

Distribution

- ❑ Linux Distribution
  - ❑ Combination of Linux Kernel, GNU Tools, Other tools and management tools
- ❑ Now more than 250 distributions
  - ❑ Major distributions: Fedora, SuSe, Ubuntu, …
- ❑ What is the difference between distribution
  - ❑ Linux Kernel Version
  - ❑ Precompiled application
  - ❑ Management tools

Proprietary version

- ❑ Proprietary: (redistribution and modification prohibited or restricted; not free)
  - ❑ Solaris - Access to a Solaris UNIX server (solaris.gl.umbc.edu) via SSH access.
  - ❑ IRIX - There are a couple of IRIX machines in the basement of the library, as well as server access (irix.gl.umbc.edu) via SSH access.
  - ❑ Mac OS X - no access currently available at UMBC.
  - ❑ and many others...

Connection to Linux

- ❑ There are really 2 means of connecting to a Linux OS
  - ❑ You can be sitting in front of a dual-bootable PC (or USB boot, or CD boot) that you have booted into Linux and logged onto.
    - ➢ All of your commands are then being run locally on that computer. When you logon in this manner you have a full GUI environment.
  - ❑ You can connect remotely to one of the Linux servers (whether from home or at the labs).
    - ➢ This is often how your projects are suggested to be developed as they are graded on those same servers. When you logon in this manner you have a command line (or text based) environment. You can also open up a command line on local lab machines as well.

Graphical User Interfaces (GUIs)

- ❑ When you logon locally, you are presented with graphical environment.
- ❑ You start at a graphical login screen. You must enter your username and password. You also the have the option to choose from a couple session types. Mainly you have the choice between Gnome and KDE.
- ❑ Once you enter in your username and password, you are then presented with a graphical environment

Inside of Linux

- ❑ More than 3 major desktops
  - ❑ GNOME, KDE, Xfce
- ❑ More than 5 major shells
  - ❑ Bash, csh, tsh, … (you can change them)
- ❑ Complete set of compilers
  - ❑ C, C++, java, Fortran, Python, Ada, …
- ❑ Many network services
  - ❑ Web, Email, File Sharing, DNS, FTP, SSH, …
- ❑ Many user applications
  - ❑ OpenOffice, Web browser, Latex, multimedia, …

Tools and Utilities

- **Text Editors**
  - Xemacs
  - Emacs
  - Pico
  - vi
- **Compilers**
  - C compiler - gcc
  - C++ compiler - g++
  - Java compiler & Java Virtual Machine - javac & java
- **Debuggers**
  - C / C++ debugger - gdb
- **Interpreters**
  - Perl - perl
  - Tcl/Tk - tcl & wish
- **Miscellaneous**
  - Web Browsers - Mozilla, Netscape, Firefox, and Lynx (lynx is text based)
  - Instant Messengers - Gaim
  - Email - Netscape is there, but we will learn Pine

Command Line Interface

- You can logon from virtually any computer that has internet access whether it be Windows, Mac, or a Linux itself.
  - In this case you are communicating through a local terminal to one of these remote servers.
  - All of the commands actually execute on the remote server.
- It is also possible to open up graphical applications through this window, but that requires a good bit more setup and software such x-win.

Linux vs Windows

- OS does not have to use a graphical interface.
  - The OS itself (the kernel) is incredibly small.
  - The GUI just another application (or set of applications) that can be installed and run on top the existing text-based OS.
- File system differences.
  - Windows typically uses FAT32 or NTFS file systems.
  - Linux typically uses the ext2 or ext3 file systems
  - In much larger research and university environments, where file access is necessary across the network, something like Network File System (NFS) or the Andrew File System (AFS) is used. We use AFS here on GL at UMBC.
  - Windows lists all drives separately (A:,C:,D:, etc…), with "My Computer" at the highest level.
  - UNIX starts its highest level at "/" and drives can be mounted anywhere underneath it.

What is X-windows

- X window is the program that draws windows on the screen under most GUI-based versions of Linux. It is important to note that the language that X windows speaks is completely different from that of Microsoft Windows or Mac OS X.
- Any X window system consists of 2 distinct parts - the X server and 1 or more X clients.
  - The server controls the display directly, and is responsible for all input/output via the keyboard, mouse or display.
  - The clients, on the other hand, do not access the screen directly - they communicate with the server, which handles all input and output.
    - It is the clients which do the "real" computing work - running applications or whatever.
    - The clients communicate with the server, causing the server to open one or more windows to handle input and output for that client.
  - **Quiz**: Is the computer in front of you a server or client?

GNU/Linux's Advantages

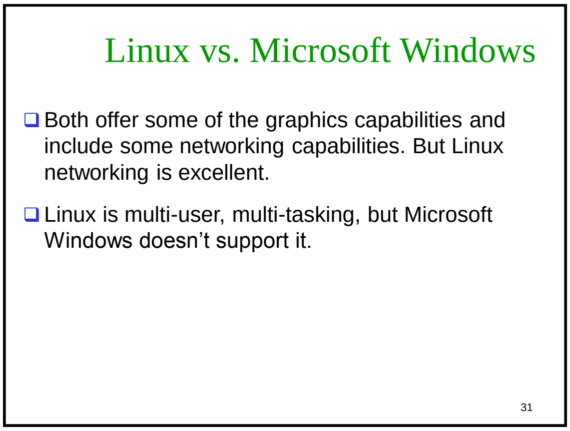
- Stability
  - It is very rarely to see the Kernel Panic
- Free Software
  - The is not any charge for software
- Support Wide Range of Hardware
  - Less memory
- Security
  - Open source → There is not any backdoor
  - Quick bug fixing

GNU/Linux's Disadvantages

- Leaning Curve
  - Linux is NOT for dummies
  - There is a book called Linux for Dummies though
- Applications
  - Some applications have NOT equivalent in Linux
  - Some applications do NOT run in WINE
- Official Support
  - Companies need official support
  - No one is responsible for most Linux applications

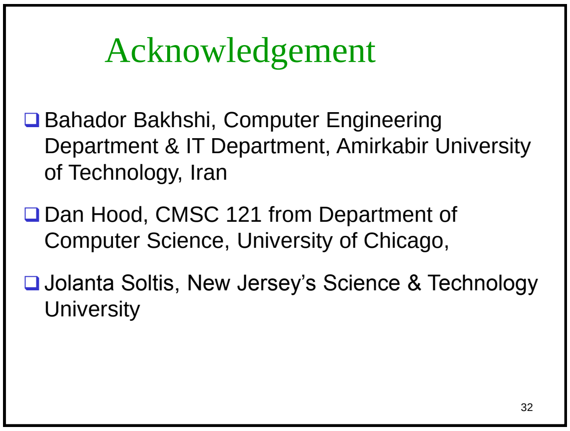
Linux vs. Unix

- Linux is free, but Unix is not.
- Unix is compatible with Linux at the system call level, meaning most programs written for either Unix or Linux can be recompiled to run on the other system with a minimum of work. But Linux will run faster than Unix on the same hardware.



Linux vs. Microsoft Windows

- Both offer some of the graphics capabilities and include some networking capabilities. But Linux networking is excellent.
- Linux is multi-user, multi-tasking, but Microsoft Windows doesn't support it.



Acknowledgement

- Bahador Bakhshi, Computer Engineering Department & IT Department, Amirkabir University of Technology, Iran
- Dan Hood, CMSC 121 from Department of Computer Science, University of Chicago,
- Jolanta Soltis, New Jersey's Science & Technology University