Linux and Statistical Computing

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Training Outline

New Hardware and Software

What is Linux?

Linux Resources

Brief History of Statistical Computing

Installing Software

SAS and Spreadsheets

Using X over the LAN/Internet

Transferring Files Through the Firewall

Keyboard Shortcuts

Emacs

If all else fails, read the instructions.
- Donald Knuth, a renowned computer scientist

New Linux Cluster runnning CentOS 7.1 (RHEL 7.1 clon

login to gouda.biostat.mcw.edu

Same username and password as
MCW email/MCWCorp/VPN/WiFi/D2L/etc.

Call the HelpDesk for password problems

CommVault backup and le recovery via the HelpDesk

PCs are not backed up: so save les on shared drives

Shares: no more Biostat domain or logging on period!

gouda: Master server

14TB of disk space and 128GB of RAM (typo xed)

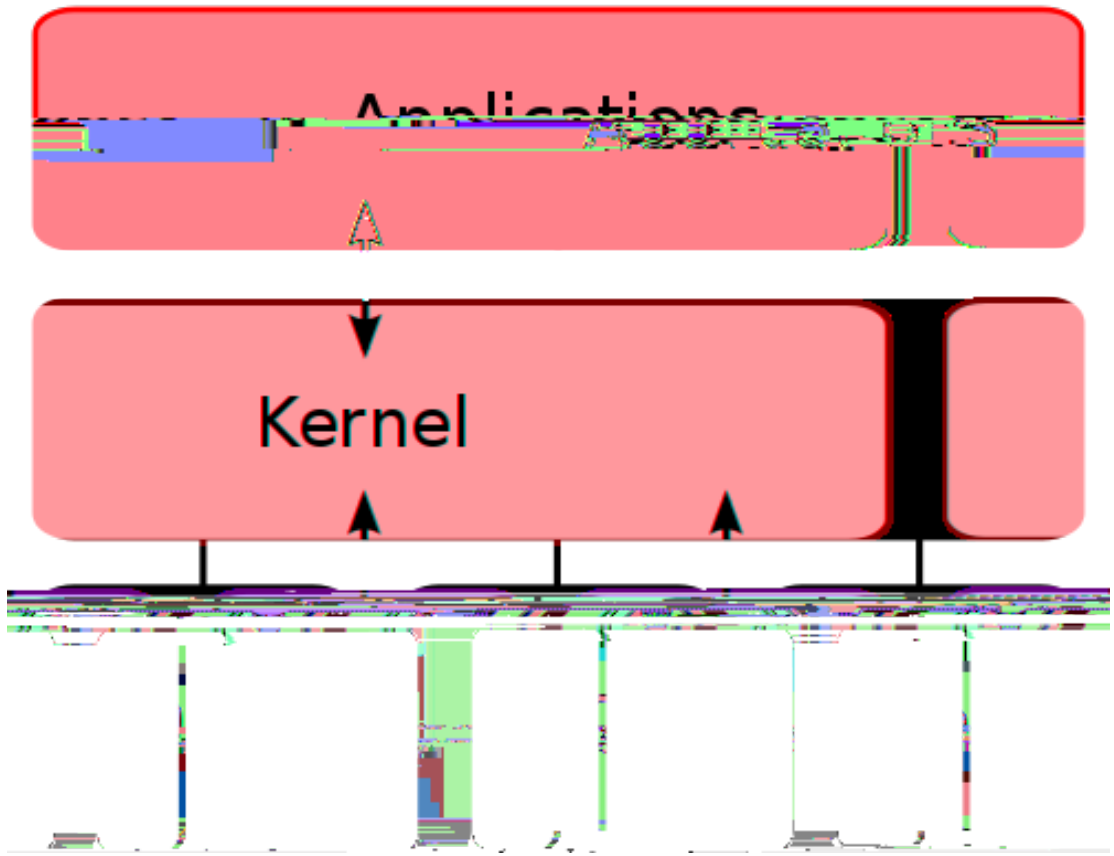
2 CPUs X 8 cores X 2 threads = 32 processes

cheddar and colby: Slaves ASAP

8 CPUs X 8 cores X 2 threads = 128 processes

Software Toolbox

What is Linux?



Linux Resources

man command, i.e. man man

info command, i.e. info info

http://www.mcw.edu/PCOR/Education.htm

The Linux Documentation Project http://www.tldp.org

The Linux Information Project http://www.linfo.org

The Stack Exchange http://stackexchange.com/sites

Wikipedia http://en.wikipedia.org

Just Google it

This presentation will be online

Computer Committee will create an online Linux FAQ

And a column in Datum: Ask the Cheese Wiz

So send us your questions and contributions

A Brief History of UNIX®

1969: AT&T Bell Labs starts work on UNIX

1970: open source UNIX provided for small fee

1972-3: Bell Labs develops C, re-writes UNIX in C

1973-8: DARPA invents TCP/IP network protocol

1978: University of California releases Berkeley Software Distribution (BSD) UNIX

1981-3: ARPANET goes TCP/IP (Internet)

1987: MIT/DEC release the X Window System

1992: AT&T files lawsuit preventing Free BSD

1994: Free BSD released; free, open source UNIX

1998-2000: SSL/SSH/VPN for Internet security

2010-3: Oracle buys Sun kills Sun Ray

A Brief History of GNU Linux

1984: Stallman creates GNU (GNU is Not Unix)
"complete, UNIX-compatible software system"
GNU General Public License (GPL)

1991-2: Linux kernel created/GPLed by Linus Torvalds

1994: Red Hat Commercial Linux is released

1997-9: GNOME GUI and package installers like yum
GNU Compiler Collection (GCC): C/C++/ FORTRAN

2002: Red Hat Enterprise Linux (RHEL) 2.1 is released

2003: Fedora project debuts, desktop/laptop-friendly

2006: CentOS, an RHEL clone, debuts

2009: X2Go 3.0 is released

2014: Red Hat funds CentOS' development
RHEL/CentOS 7.1 released based on Fedora 19

A Brief History of S and R

Late 70s: S, an intepreted, object-oriented statistical programming language developed by Bell Labs

1980: Bell Labs develops C++

Early 80s: the S language was licensed by AT&T for educational and commercial purposes

1997: GNU R software for UNIX/Linux, Windows & Mac
Comprehensive R Archive Network (CRAN)

2001: The Bioconductor Project launches to develop free software R packages for bioinformatics

2005: Rcpp package, seamless R and C++ integration

2014: R breaks into top 20 most popular languages
currently 12th on TIOBE Index (SAS is 24th)

2015: CRAN currently has 6700 R packages
The Bioconductor Project reaches 900 packages

A Brief History of SAS

1966-8: Anthony Barr develops SAS language

1968: Barr and James Goodnight develop ANOVA and multiple regression procedures for SAS

1973: John Sall joins the project

1976: SAS Institute is incorporated by Barr, Goodnight and Sall

1988: Modern SAS era begins
SAS v. 6 re-written in C for portability, adds support for UNIX, X, etc.

1993: SAS for Windows appears

1996: My GPL SAS macro library RASmacro begins

1999: SAS v. 8 released with support for Linux

2013: SAS v. 9.4 released

What are packages?

Package: a frequently overused term in free software

- Linux packages: binary distributions of free software
- Such as Extra Packages for Enterprise Linux (EPEL) https://fedoraproject.org/wiki/EPEL
- R packages available on CRAN http://cran.r-project.org
  - StatLib http://lib.stat.cmu.edu/R/CRAN
- More confusing: some R packages on EPEL like qtl
- LaTeX packages like beamer, graphicx, etc.
- Emacs Lisp Package Archive https://elpa.gnu.org
  - where AUCTeX can be found for example

Installing software

```
sudo yum install emacs # superuser only
compenv # print compiler environmental variables
mc ~/local/src/emacs
wget http://ftp.gnu.org/gnu/emacs/emacs-24.5.tar.gz
tar xzf emacs-24.5.tar.gz
cd emacs-24.5
# with GNU autotools
configure --prefix=~/local # configure --help
nohup make >& all.txt &
make install
```

Installing R packages
http://community.amstat.org/wisconsinchapter/blogs/rodney-sparapani/2013/04/05/installing-r-and-bioconductor-tips-updated-with-rgraphviz-info

SAS and spreadsheets

Use the Comma Separated Value format, i.e. .csv

Standard le format used with FORTRAN since late 60s

Use PROC IMPORT to read in

Use %_cimport SAS macro when PROC IMPORT fails

See the documentation at
/usr/local/sasmacro/_cimport.sas

Use PROC EXPORT to create

Using X over the LAN/Internet

The X Window System AKA X protocol is backwards

The X server is your PC and the client is the server

Fonts come from your PC: xlsfonts to list them

At Work or Home: use X2Go for X acceleration
via NX compression/caching of X data

MATE Desktop vs. Single Application

From Home: I use a single application due to latency

/usr/bin/xterm or /usr/local/bin/emacs

Transferring Files Through the Firewall From the Command Line

```
rho% mkdir ~/.ssh; chmod 700 ~/.ssh; ssh-keygen

rho% cd ~/.ssh; cp id_rsa.pub authorized_keys
gouda% scp -r USER@rho:.ssh .
rho% cd FROM
rho% tar cf FILE.tar FILES-OR-DIRECTORIES
rho% gzip FILE.tar
gouda% scp rho:FROM/FILE.tar.gz TO
gouda% cd TO; tar xzf FILE.tar.gz
```

Standard Keyboard Shortcuts

GNOME Human Interface Guidelines (HIG)
http://developer.gnome.org/hig-book/3.0/input-keyboard.html.en#standard-shortcuts

IBM Common User Access (CUA)

Cut	Sh-Delete
Copy	C-Insert
Paste	Sh-Insert

Emacs and Modes

gouda:~:$ emacs & # & runs in the background\verb
User init le: ~/.emacs
Global init le:
/usr/local/share/emacs/site-lisp/default.el
Debug inits: emacs --debug-init &
Start without inits: emacs --no-init-file &
List command line options: emacs --help
Emacs is a Lisp interpreter (.el) and byte-compiler (.elc)
Modes installed on gouda (written in Lisp)

Emacs and ESS on the web

http://www.mcw.edu/pcor/education/sas/xemacs.htm
http://ess.r-project.org
http://blog.revolutionanalytics.com/2014/03/emacs-ess-and-r-for-zombies.html
http://www.damtp.cam.ac.uk/user/eglen/ess11/index.html

Emacs Command Keys

Modi er Keys

C-KEY means hold down the Control key while pressing another KEY. For example, C-x means hold down Control while pressing x.

Sh-KEY means hold down the Shift key while pressing another KEY.

M-KEY means hold down the Meta key while pressing another KEY. On PC (Mac) keyboards, the Meta key is usually the Alt (Option) key. If you don't have a Meta key, you can press Esc, release, and then press KEY.

Execute an emacs command: M-x COMMAND Enter

M-x list-packages Enter

M-x list-fontsets Enter

C-u M-x list-fontsets Enter (C-u is called pre x arg)

Emacs Common Commands

Getting out of Trouble

- Cancel current command: C-g
- Exit Emacs: C-x C-c

File Commands

- Open a file or directory: C-x C-f
- Open a file/URL in the cursor: right mouse button
  M-x ffap-file-at-point
- Save a file: C-x C-s
- Refresh a file: F2 (ESS-g 0 G 0

Emacs Text Commands

Undo changes: C-x u

Cut region: Sh-Delete (CUA)
- Delete (local shortcut)
- C-Delete (local shortcut)

Copy region: C-Insert (CUA)
- Insert (local shortcut)
- M-w

Paste region: Sh-Insert (CUA)
- Middle mouse button
- C-y (yank command)

Select whole buffer as region: C-x h

Cut a rectangle of text: C-x r k
- M-x kill-rectangle

Emacs Text Commands (cont.)

Paste a Cut rectangle of text: C-x r y
M-x yank-rectangle

Fill paragraph: M-q

Emacs Search and Replace

Search forward: C-s (Return stops search)

Search backward: C-r (Return ...)

Search forward w/ wildcards: M-C-s (Return ...)

Search backward w/ wildcards: M-C-r (Return ...)

Query-replace: M-%
y for replace, n no replace, ! replace all, Return ...

Emacs Buffer Commands

Switch to the *shell* buffer: F8 (ESS)

Send Control character: C-q C-KEY

Split window for two views above/below: C-x 2

Unsplit window: C-x 1

Split window for two views left/right: C-x 3

Close a buffer: C-x k

List all buffers: C-x C-b

vi emulation on: M-Esc (local shortcut)

vi emulation toggle off/on: C-z
(from vi command mode to emacs and back)

New emacs window (frame): C-menu (local shortcut)
M-x make-frame-command

Emacs Cursor Commands

Move to beginning of line: C-a
Home

Move to end of line: C-e
End

Beginning of le: C-Home

End of le: C-End

Page up: PageUp
M-v

Page down: PageDown
C-v

Forward word: M-f

Backward word: M-b

Emacs Help Commands

Emacs tutorial: C-h t or F1 t
(F1 is a short-cut for C-h)

Emacs manuals: F1 i

Search for command: F1 a TEXT

Help for a key: F1 k KEY

Help for an Emacs variable: F1 v VARIABLE

Help for an Emacs function: F1 f COMMAND

Help for an Emacs mode: F1 m

Help for all keys currently available: F1 b

Help from a man page: M-x man

Help from info: M-x info

Emacs ESS[SAS] Commands

Batch submit a .sas program: F3

Switch to the .sas buffer: F4

Switch to the .log, refresh and search for errors: F5

Switch to the .lst and refresh: F6

Switch to the .txt and refresh: F7

Open a SAS dataset with PROC FSVIEW: F9

View a GSASFILE graph: F12

Emacs ESS[R] Commands

Start R: M-x R

Submit whole buffer: C-c C-b

Submit active region: C-c C-r

Submit current paragraph: C-c C-p

Submit current line: C-Enter

Retrieve previous typed command line: C-UpArrow
(in *R* and *shell* buffers)

Retrieve next typed command line: C-DownArrow

Assignment: < (generates <-)

Less than: << (generates <)