

Analysis Methods in Atmospheric and Oceanic Science

AOSC 652

Ross Salawitch, Jeff Henrikson, Tim Canty, and Walt Tribett

Web Site: <http://www.atmos.umd.edu/~rjs/class/fall2016/>

29 Aug 2016

Textbooks:

[FORTRAN 77 Programming](#) (2nd edition, 1990) by T. M. R. Ellis

[Numerical Recipes in FORTRAN 77: The Art of Scientific Computing](#)

(2nd edition, 1992) by William H. Press et al.

On line pdf: <http://www.nrbook.com/a/bookfpdf.php>

[Numerical Analysis](#) by Richard L. Burden and J. Douglas Faires

Specialty textbooks used second half of course:

[An Introduction to Programming with IDL](#) by Kenneth P. Bowman

[Numerical Computing with MATLAB](#) by Cleve Moler

[Python Programming and Visualization for Scientists](#) by Alex DeCaria

Organization Details

- Instructors:
 - [Ross Salawitch](#), Jeff Henrikson, [Tim Canty](#) (**IDL**) and Walt Tribett (**TA**)
- Grading:
 - attendance and class participation: 10%
 - weekly assigned projects: 70%
 - *on time submission encouraged because if you fall behind, it is difficult to catch up*
 - final project: 20% (will discuss as class progresses)
 - **no exams!**
- Office hours:
 - Ross: CSS 2403; phone 5-5396; rjs@atmos.umd.edu
 - Jeff: CSS 2425; phone 5-5357; jhenriks@umd.edu
 - Walt: CSS 4100; wtribett@umd.edu
 - Tim: CSS 3427, phone 5-5360; tcanty@umd.edu (Tim will be present only for IDL portion of class)
 - Office Hours By Appointment (Friday classes typically serve as in class office hrs)
- Student Survey
 - We will “tailor” this class to student needs and capabilities, as best we can
- Honor Code
 - Fine to turn in code that is incomplete, does not quite work, etc. We aspire to create an enjoyable class room setting for learning to write computer programs to solve numerical problems. We hope to create an environment that is not too stressful... no matter what, **do not copy code from another student**

Organization Details, Continued

- Typical Week
 - Mon: presentation of “theory” underlying specific topic
 - Wed: instructor led development of prototype code to solve numerical problem related to specific topic
 - Fri: review of last week’s assignment, loose ends, then students work on weekly assignment, with instructors present as “on call” consultants
- Readings
 - Will be posted on class website, under weekly page
 - Three passwords to track:
 - 1) personal password (only you have access to this!)
 - 2) AOSC Helper webpage (www.atmos.umd.edu/~helper)
 - 3) Copyright PDF files posted on our class webpage

Succinct History of Operating Systems Used by Atmospheric & Oceanic Scientists

- Unix
 - Bell Labs, early 1970s
 - Proprietary
 - Competed with VAX/VMS
- GNU: stands for GNU is Not Unix (recursive anagram)
 - Developed by Richard Stallman in mid 1980s
 - Included emacs and public C compiler
 - Work on core kernel “stalled”
- Linux
 - Developed by Linus Torvalds in early 1990s
 - Functionally very similar to Unix
 - Public:
 - source code is free
 - community can (and does!) contribute to kernel
- VAX/VMS
 - Developed by Digital Equipment Corporation (DEC) in the mid-1970s
 - Programming environment first used by one of us (the one who learned programming in the mid-1970s ☺)
 - Command line syntax rich, more intuitive than Unix or Linux
 - Inherent file versioning

Succinct History of Operating Systems Used by Atmospheric & Oceanic Scientists



Image source: <http://en.wikipedia.org/wiki/VAX>

More info on VAX/VMS: <http://en.wikipedia.org/wiki/OpenVMS>

Computational Tools Used by Atmospheric & Oceanic Scientists

- AOSC 652 Computational Platform
 - redhat linux on the KDE desktop environment
 - https://en.wikipedia.org/wiki/Red_Hat_Linux
 - <https://en.wikipedia.org/wiki/KDE>
- AOSC 652 Computational Tools
 - FORTRAN 77
 - fastest number cruncher around
 - preferred tool to handle large datasets or three dimensional, geophysical calculations
 - we'll use F77, rather than F90, because many AOSC legacy codes are written in F77 and, if one learns F77, then F90 is trivial to pick up
 - many public FORTRAN compilers: unfortunately, different syntax rules for obscure statements (some of which R. Salawitch uses often in his legacy codes)
 - IDL (Interactive Data Language)
 - can easily manipulate arrays and matrices
 - excellent data visualization tool: many images of “ozone hole”, “El Niño”, etc generated using IDL
 - proprietary (and expensive!)
 - MATLAB
 - excellent tool for solving ODEs, PDEs, Fourier Analysis
 - nice graphical capabilities

Computational Tools Used by Atmospheric & Oceanic Scientists

- AOSC 652 Computational Tools, new for 2016
 - **Python**
 - easy to learn “object oriented” programming language
 - open source: commonly available on Linux platforms
 - new kid in town!

Computational Tools Used by Other Physical Scientists

- Computational Tool Used by some Atmospheric and Oceanic Scientists:
 - GrADS
 - plotting program used by meteorologists
 - detailed info available at <http://www.atmos.umd.edu/~gcm/usefuldocs/grads.html>
- Physics community:
 - [Mathematica](#) is most commonly used; provides elegant closed form solutions to differential equations and nice plotting software
- Chemical community:
 - Specialized software tools such as [FASCIMILIE](#) (solves coupled ODEs describing chemical kinetics), [MODTRAN](#) (atmospheric radiative transfer), and a plethora of tools for [quantum chemistry](#) and [organic chemistry](#)

Computational Tools Used by Atmospheric & Oceanic Scientists

- AOSC652
 - Linux
 - nearly everyone will be spending a lot of time in a linux environment
 - FORTRAN 77
 - fastest number cruncher & language of many legacy codes
 - IDL (Interactive Data Language)
 - pretty pictures of satellite data or model output
 - MATLAB
 - tool of choice for a few faculty members
 - Python
 - easy to learn, open source, increasingly popular

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Bad news:

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Bad news: use of Excel is not allowed !

Remote Access

- In class environment
 - metosrv8 (this room only)
- Remote access
 - ssh aosc-gw.umd.edu (portal)
 - From aosc-gw: ssh halo-vm (this environment)
 - Can set up a KDE environment if accessing from a Mac
 - Should install UMd Virtual Private Network (VPN) on your remote computer for access to be more functional
https://umd.service-now.com/cf/kb_find.do?sysparm_search=virtual%20private%20network
 - We'll describe Remote Access in a few weeks
 - **For first 2 weeks of class, we strongly encourage students to complete assignments in this room to gain familiarity with this environment!**

Class Email

- **Class email**
 - **When sending class related email:**
 - Please include AOSC 652 in subject of message
 - If your email is about general class info, best to include
Ross Salawitch (rjs@atmos.umd.edu)
Jeff Henrikson (jhenriks@umd.edu)
Walt Tribett (wtribett@umd.edu)
 - If your email is about IDL, please also include Tim Canty, at:
Tim Canty (tcanty@umd.edu)
 - If your email is about system administration issues, please email
Jeff Henrikson (AOSC Sys Admin)

Between Now and Wednesday

- **Between now and Wed**

- **Read up on general Linux info (see links on the parent page)**

- Familiarize yourself with basic commands for copying files, moving files, etc.
- We'll spend time Wed on these basic commands

- **Determine which Linux text editor is “right for you”**

Choices: vi, emacs, nano, nedit, etc

- Talk to other students !
- This is not an iron clad decision; we'll be happy to help you switch to another editor, should you so desire

- **Printout and complete Honor Code and Student Survey (parent page)**

- If you do not have access to this building and this room “after hours”, please see June Sherer, room 3407 CSS Bldg to arrange.

Print out and complete this form:

<http://www.atmos.umd.edu/services/personnel/CardKeyAccess.pdf>

before seeing June. Request access to CSS building as well as rooms 3408 & 3426

If you are an AOSC student *or* your research is supported by an AOSC faculty member, please do not write anything about the course on the form, as your access should extend after the class. Otherwise, please note AOSC 652 on the form

- If you do not have access to the AOSC system, please establish username ASAP (see Jeff right after class)

Between Now and Wednesday

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- **What is a subdirectory?**
- **How is a subdirectory created?**
- **How does one move between subdirectories?**
- **What is the difference between copy and move?**
- **How does one copy a file?**
- **How does one move a file?**
- **How does one edit a file?**

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- **Prior to 11:00 am on Wed, 31 Aug**

- Email me, Jeff, and Walt ***your Linux editor preference***
 - We'll collect results and present in class on Wednesday

Class Email Alias

I have sent an email to the UMEG generated alias with subject
“Welcome to AOSC 652”

Who **DID NOT** get this email message?

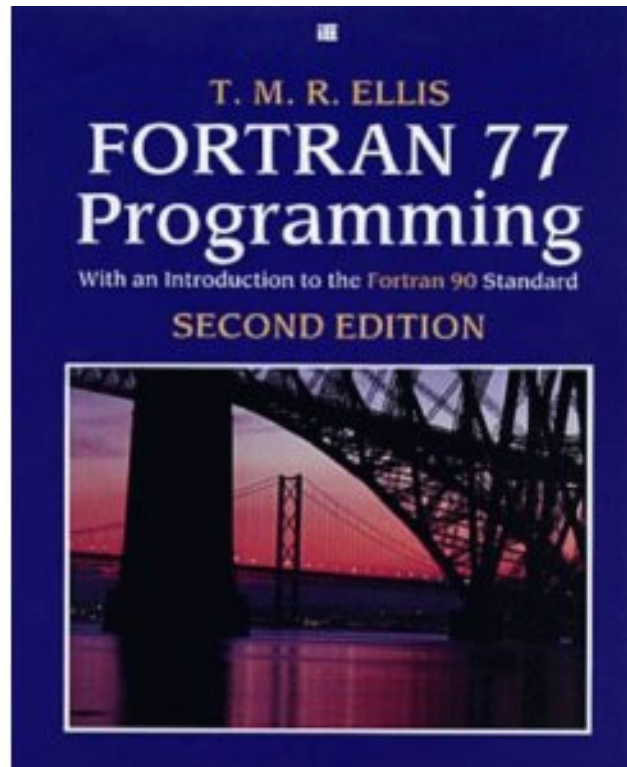
If you have not brought \$20 to class today,
please bring on Wednesday 😊

Book is out of print

We have acquired enough copies for the entire class!

We require \$20 collateral, for your use of the book during the semester

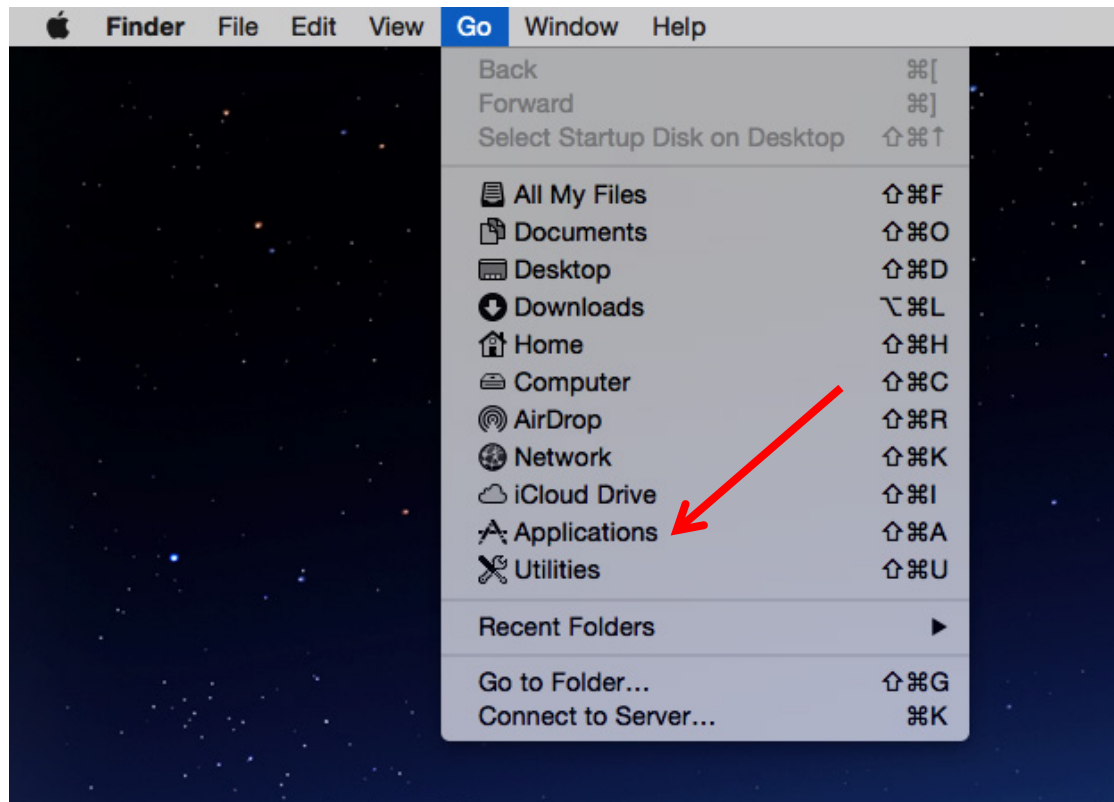
At the end of the semester, you return the book, we return your \$20



AOSC 652: Let's Login To Linux

Log in Steps

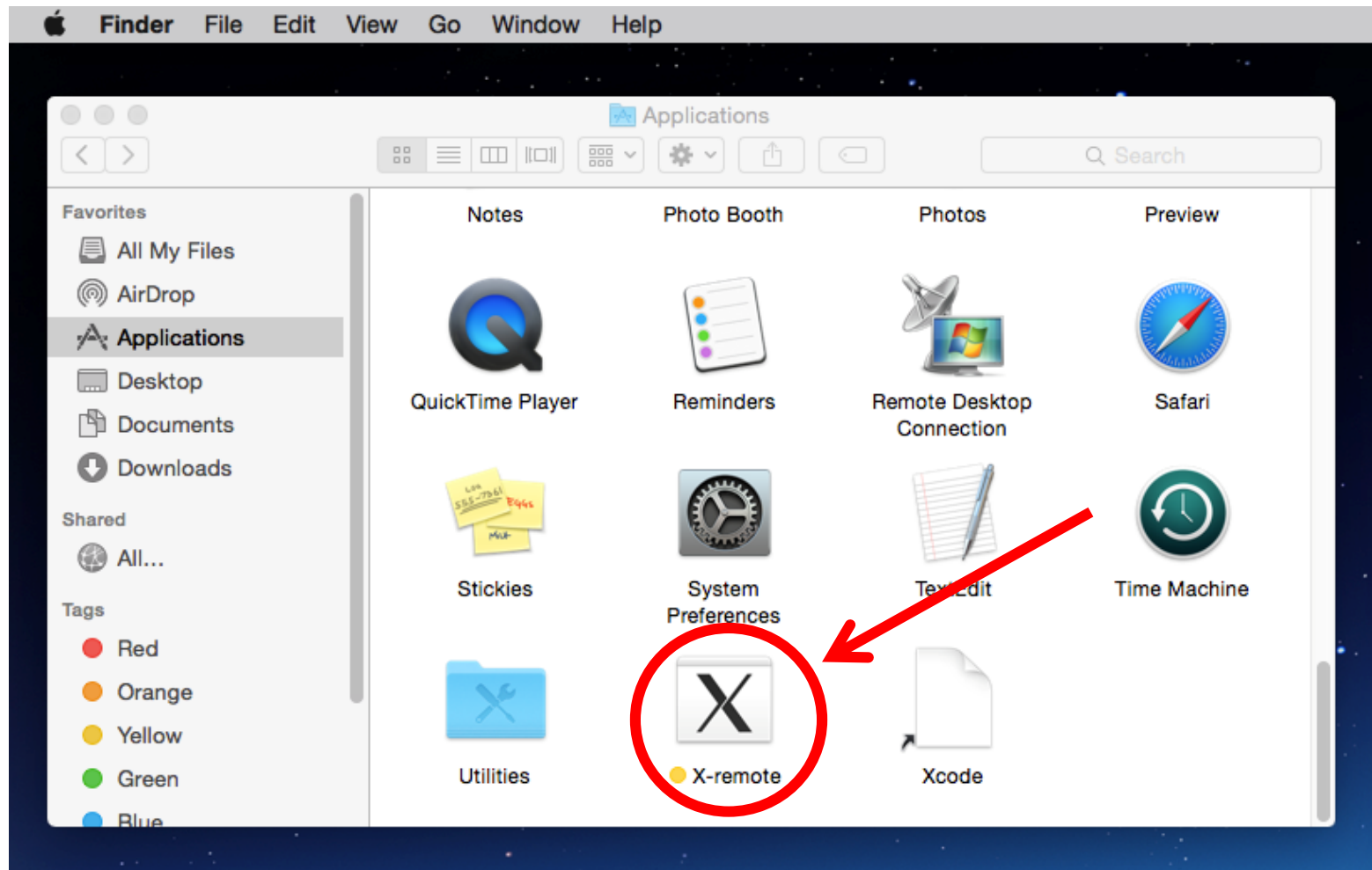
1. Enter your AOSC user name and AOSC password on the initial Apple login screen (not shown)
2. Under “Go” at the top, click Applications



AOSC 652: Let's Login To Linux

Log in Steps

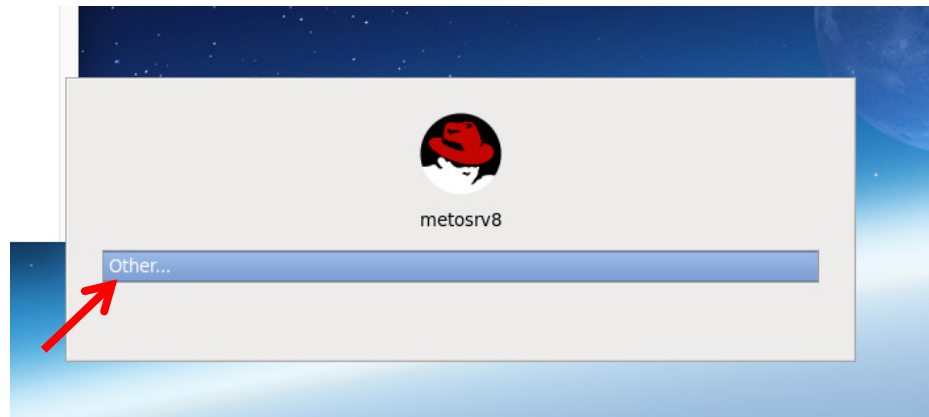
3. In the Applications folder, open X-Remote.



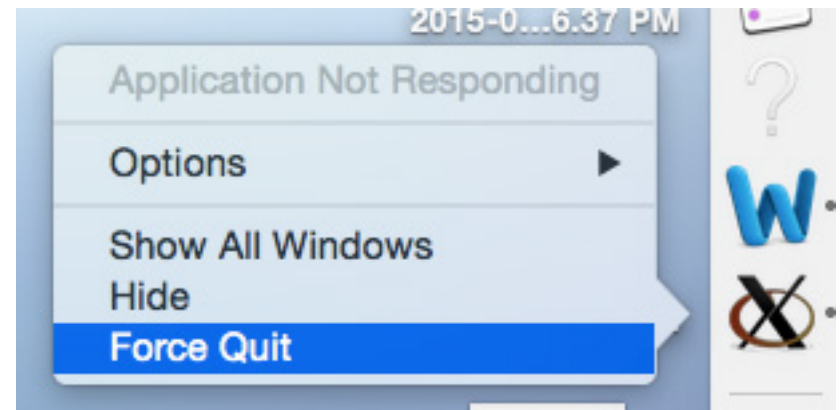
AOSC 652: Let's Login To Linux

Log in Steps

4a. Wait for the white terminal window and a redhat popup to appear and click “Other...” (If a white terminal appears, but no redhat popup appears after a short wait, see 4b)



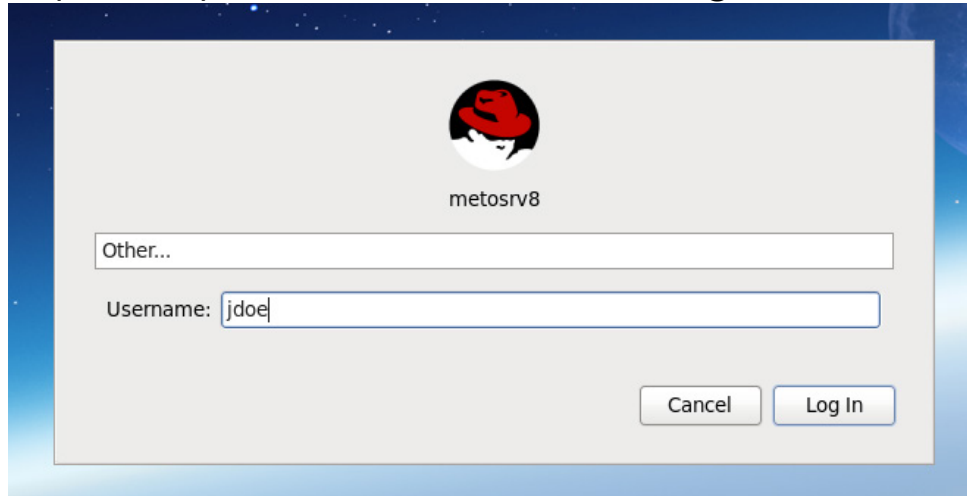
4b. If the above popup did not appear, right click the X11 icon on your dock bar and 'Force Quit'. Then close all terminal windows and try again from step 2



AOSC 652: Let's Login To Linux

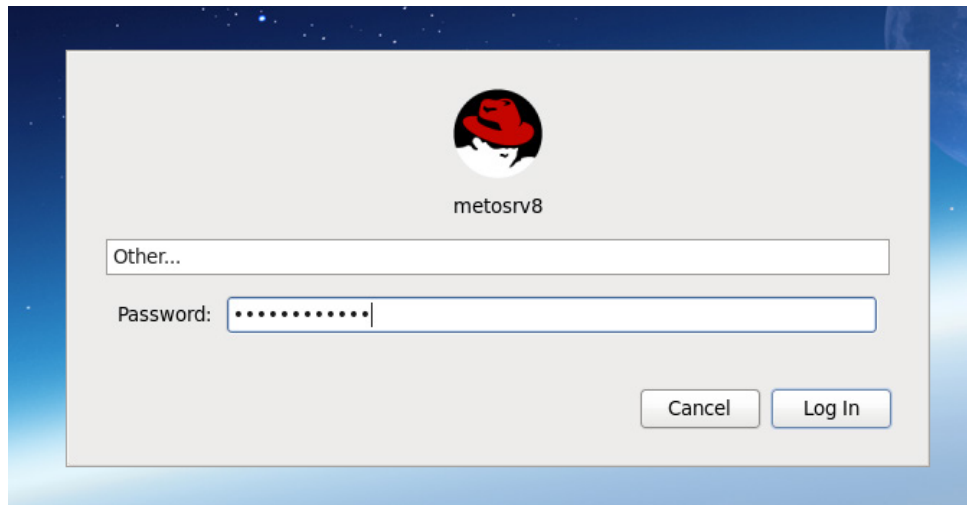
Log in Steps

5. Enter your (AOSC) user name and click log in



The screenshot shows a login window with a blue gradient background. At the top center is a circular icon of a red devil with horns and a pitchfork, with the text 'metosrv8' below it. Below the icon is a text input field labeled 'Other...' which is empty. Underneath that is a text input field labeled 'Username:' containing the text 'jdoe'. At the bottom right are two buttons: 'Cancel' and 'Log In'.

6. Enter your (AOSC) password and click log in



The screenshot shows the same login window as above. The 'Other...' field is still empty. The 'Password:' field is now filled with ten dots. The 'Cancel' and 'Log In' buttons remain at the bottom right.

AOSC 652: Let's Login To Linux

Log in Steps

7. If this popup appears click cancel.

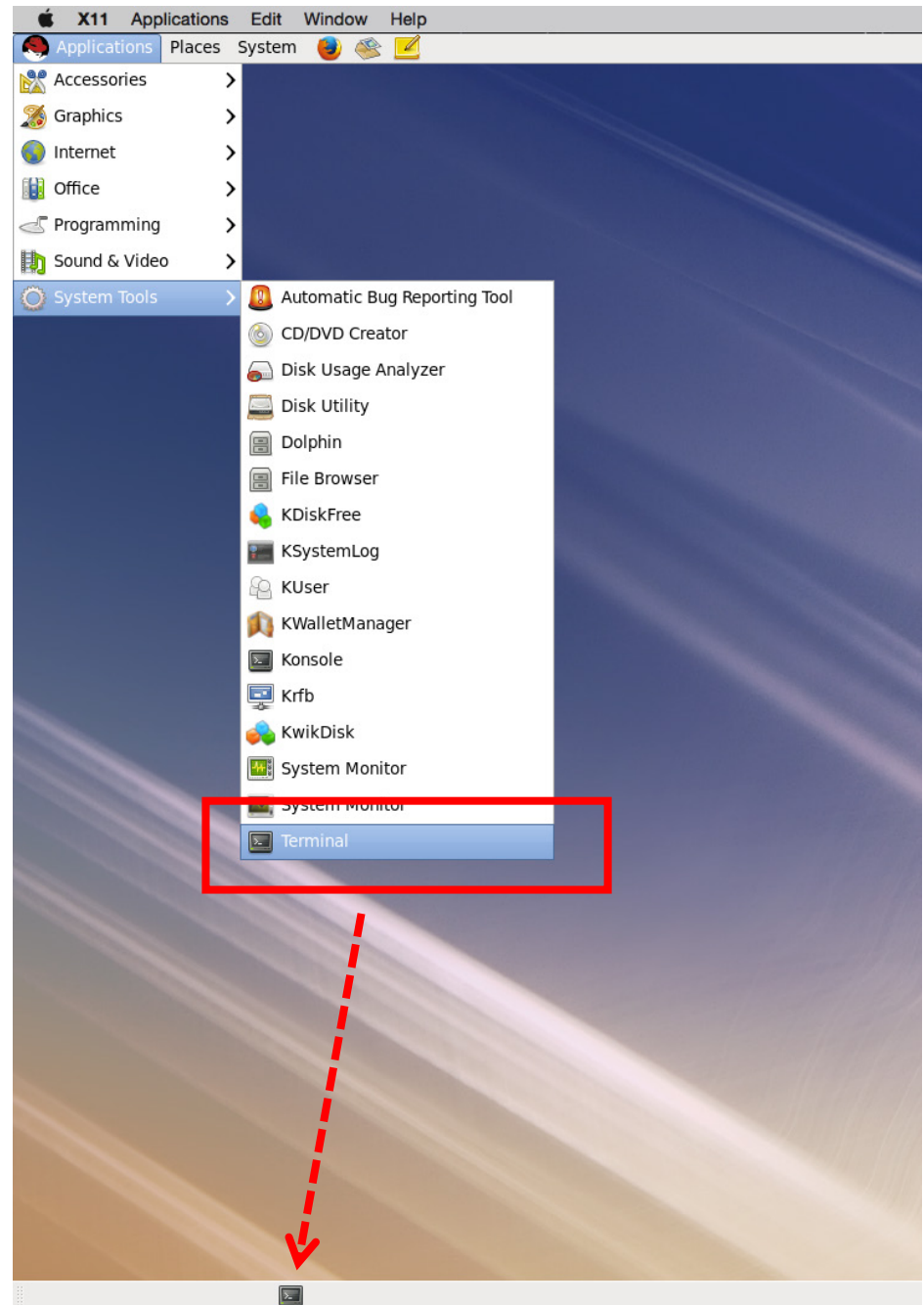


Strongly Suggested Tip

Often times several open terminal windows will be used. It is very useful to create a shortcut on your taskbar to open new terminal windows.

To do this, click “Applications” and mouse over “System Tools”; then click drag and drop the terminal icon to the lower taskbar (see right)

It may also be helpful to set the mac OS dockbar to the right side of the screen so that it does not block the Linux taskbar



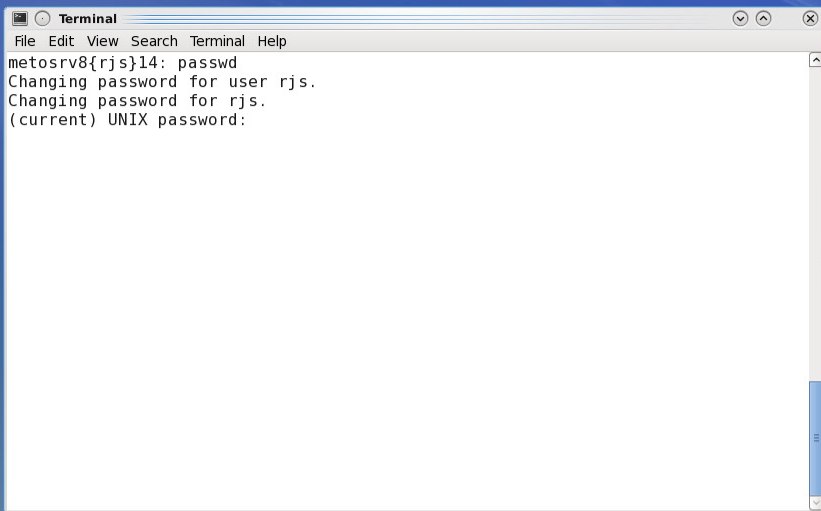
```
Terminal
File Edit View Search Terminal Help
metosrv8{rjs}14: passwd
Changing password for user rjs.
Changing password for rjs.
(current) UNIX password:
```

New users: please change your password

Enter passwd

Follow directions 😊

Whatever you enter will be your new aosc system psswr



A terminal window titled "Terminal" with a menu bar (File, Edit, View, Search, Terminal, Help). The output shows a user at a shell prompt changing their password. The prompt is "metosrv8{rjs}14:". The user enters "passwd", and the system responds with "Changing password for user rjs." and "Changing password for rjs." followed by "(current) UNIX password:". The terminal has a scrollbar on the right.

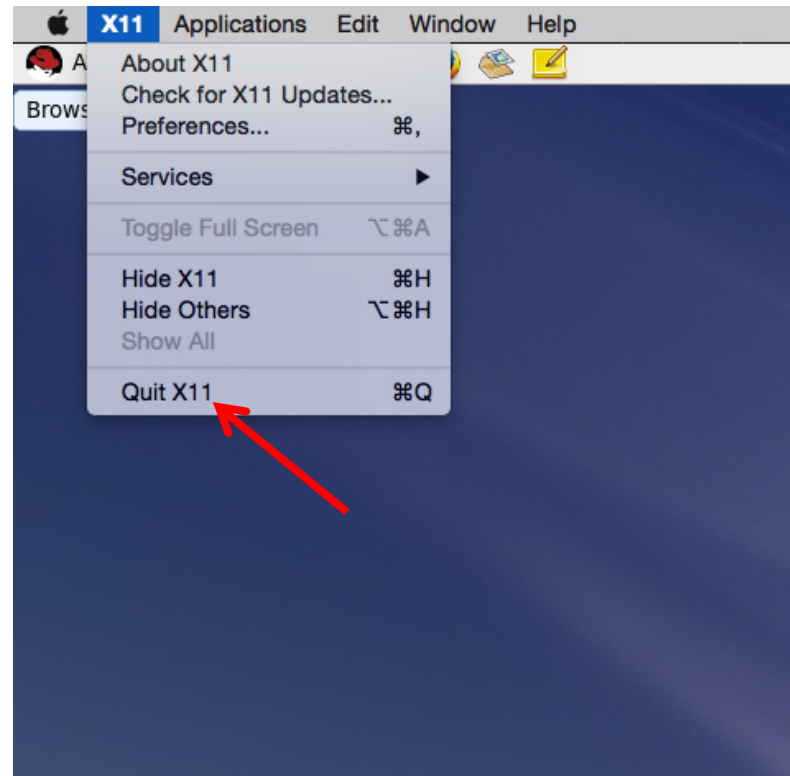
```
metosrv8{rjs}14: passwd
Changing password for user rjs.
Changing password for rjs.
(current) UNIX password:
```

- Would be wonderful if prior to start of class on Wed, everyone could:
- a) login to the linux KDE environment
 - b) complete your various assignments for Wed (including selection of Linux editor & emailing me with your selection)
 - c) familiarize yourself with material posted on Week 1 of class webpage !

AOSC 652: Logging out Properly Is Important

Log out Steps

1. To log out click the X11 on the top menu bar and select “Quit X11”.
(If you do not see X11 at the top try clicking the Linux wallpaper background on the screen)



AOSC 652: Logging out Properly Is Important

Log out Steps

2. Click the apple in the top left corner and select “Log Out”

