PY410 / 505
Computational Physics 1

Salvatore Rappoccio

Technical Lectures

- We will have several technical lectures to get you up to speed with programming and technical skills
  - Using UNIX/LINUX command line
  - Compiling, version control
  - Data representations, flow of control, object oriented programming, simple algorithms

Executing code

- We will have two environments officially supported:
  - Docker image for class software (Ubuntu based):
    - https://hub.docker.com/r/srappoccio/compphys
  - Vidia (for those who register at UB)
    - https://vidia.ccr.buffalo.edu

- Software for this class:
  - https://github.com/rappoccio/CompPhys

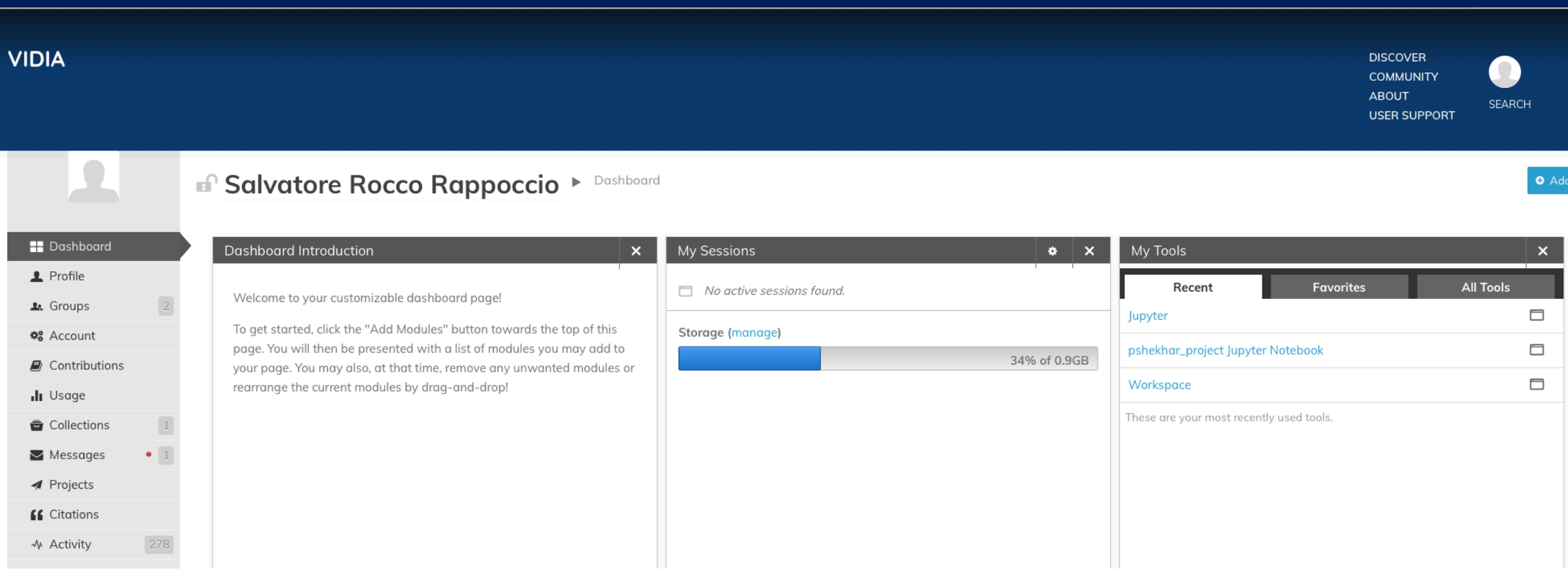
- If you want to use your laptop environment directly, you can but CAVEAT EMPTOR.

I assist students with laptop issues on best-effort basis

VIDIA : For those registered at UB

- Registering: https://vidia.ccr.buffalo.edu

VIDIA : Logging in the first time

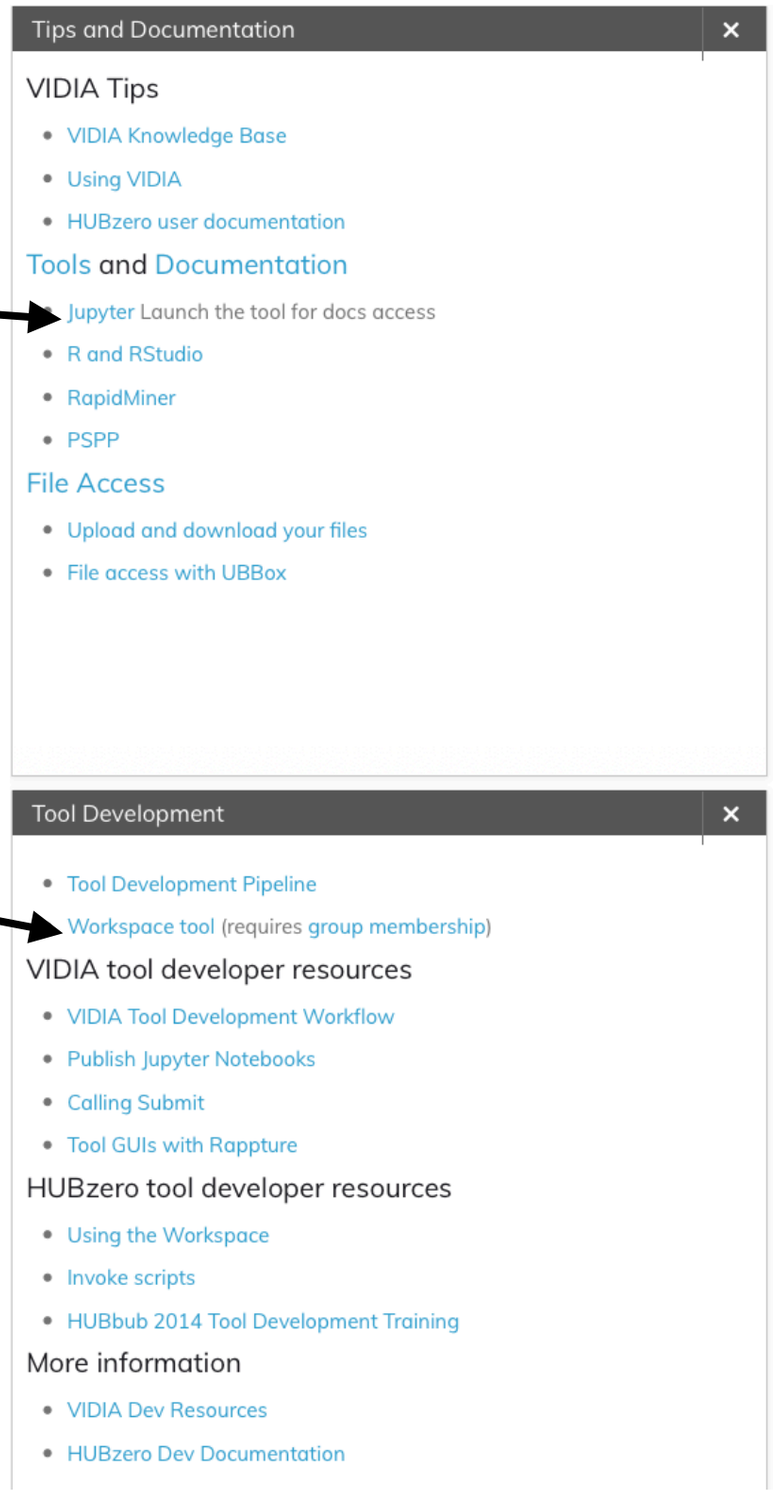


Scroll down

VIDIA : Logging in the first time

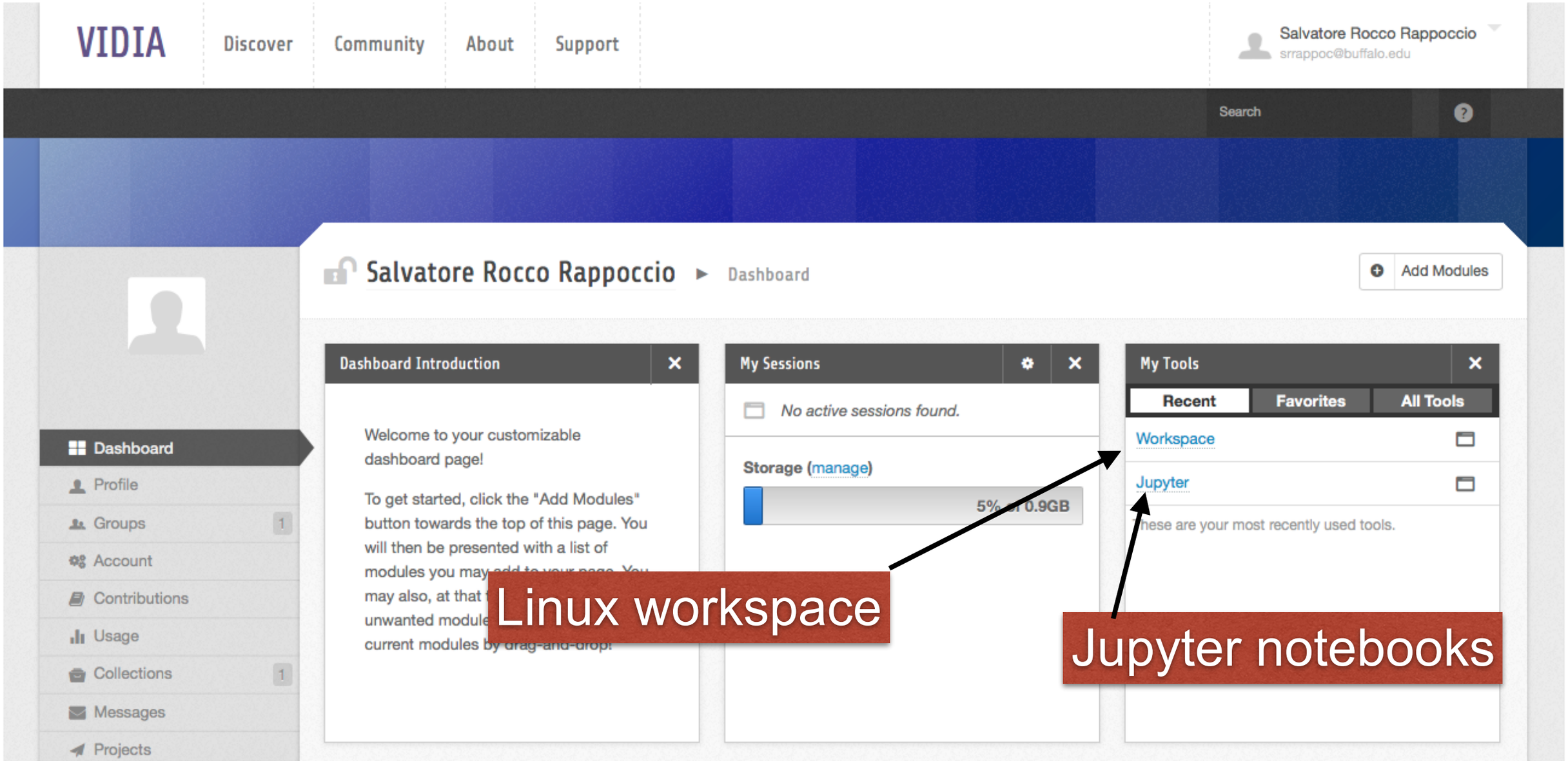
Jupyter notebooks

Linux workspace



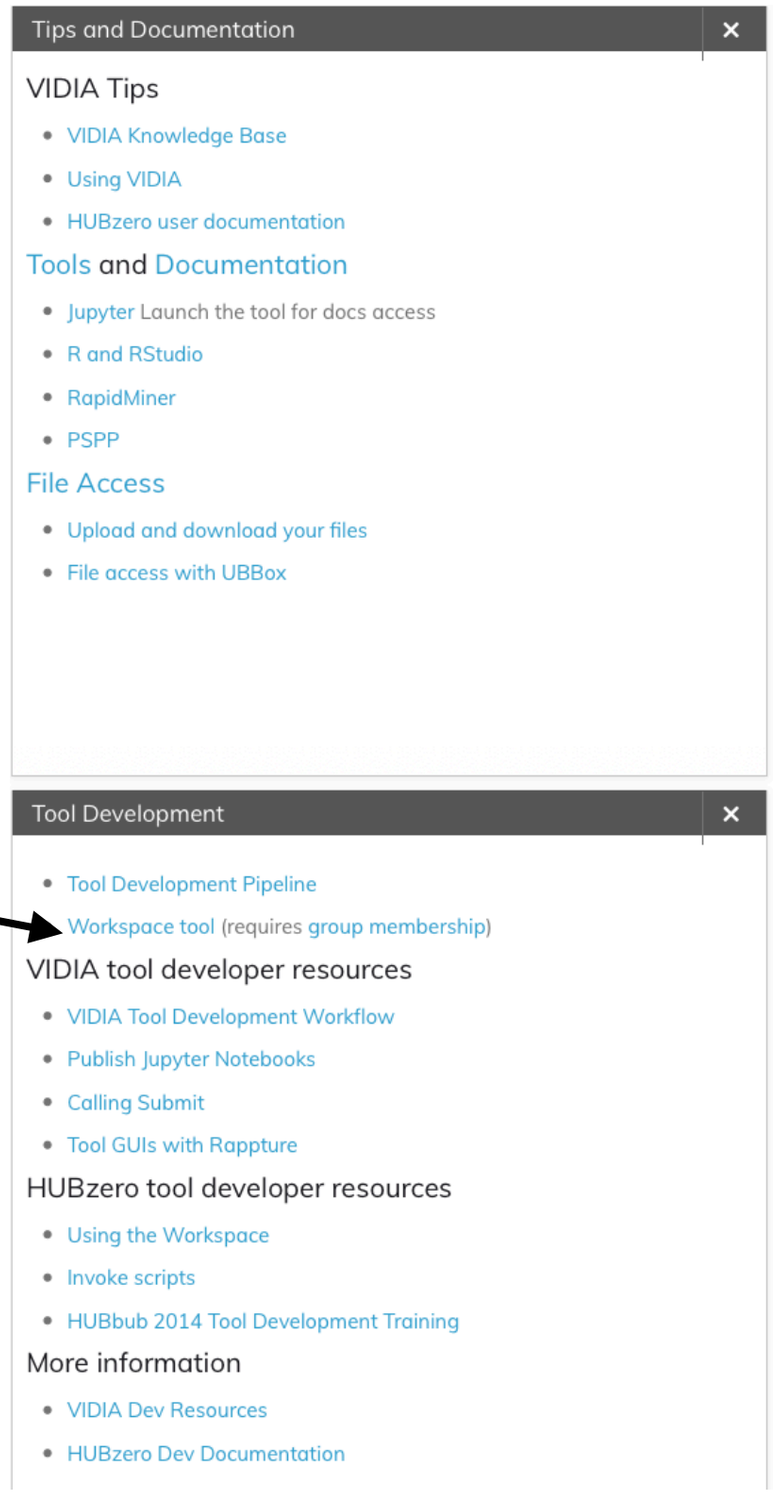
VIDIA : After you have used Workspace or Jupyter

- Workspaces and Jupyter

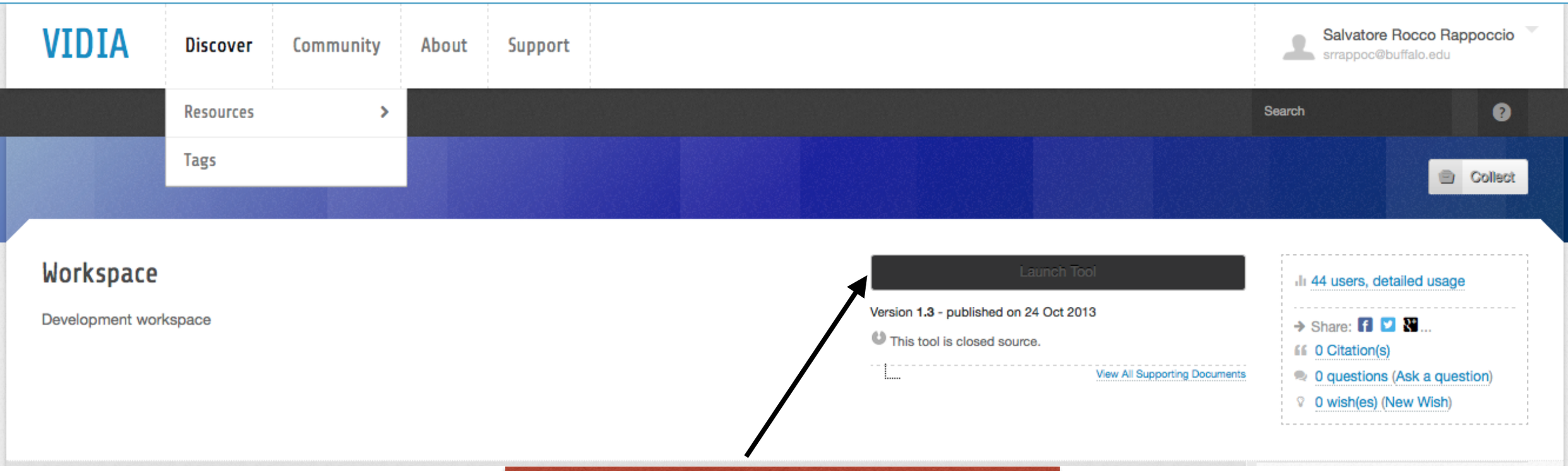


VIDIA : Workspace tool

Linux workspace

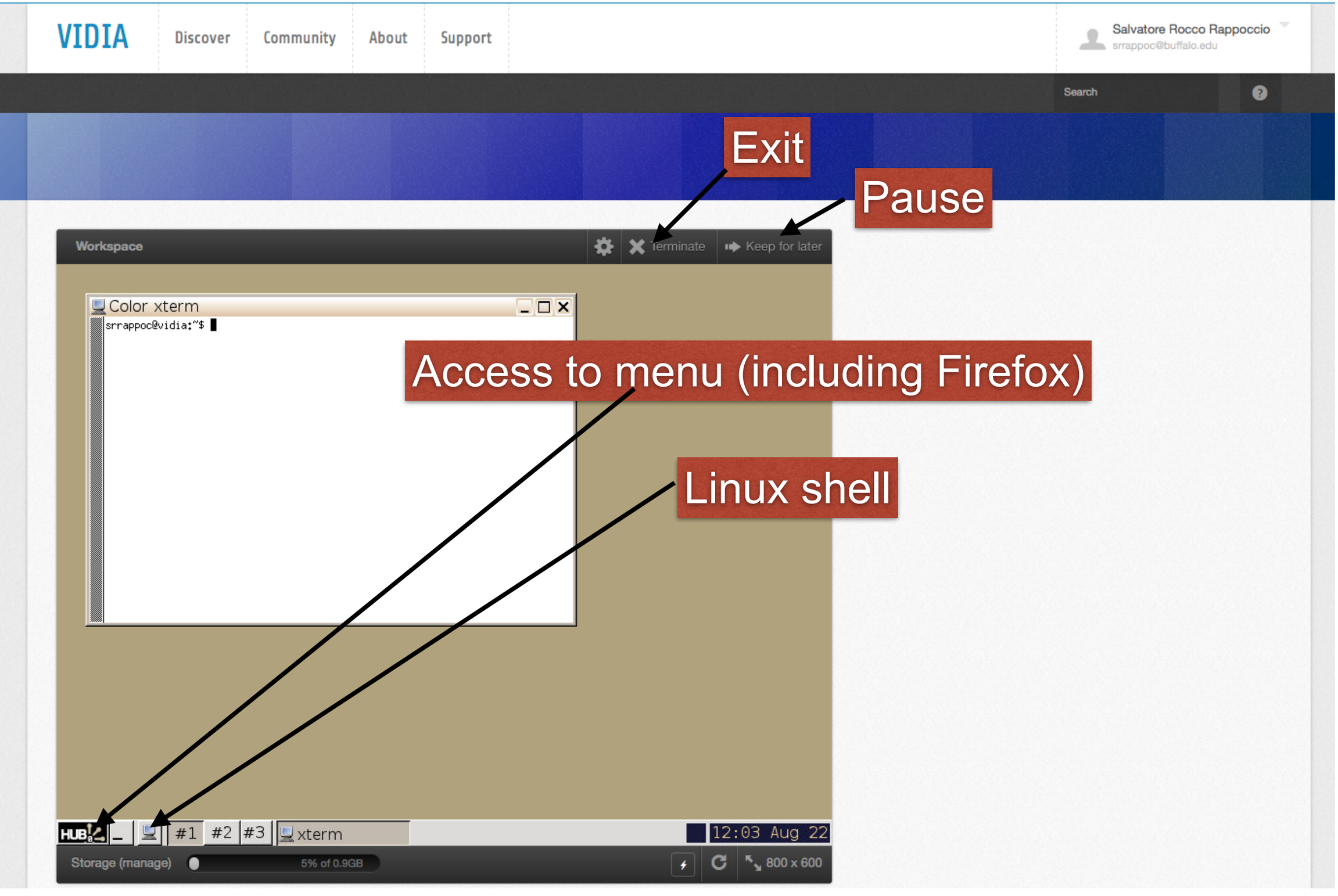


VIDIA



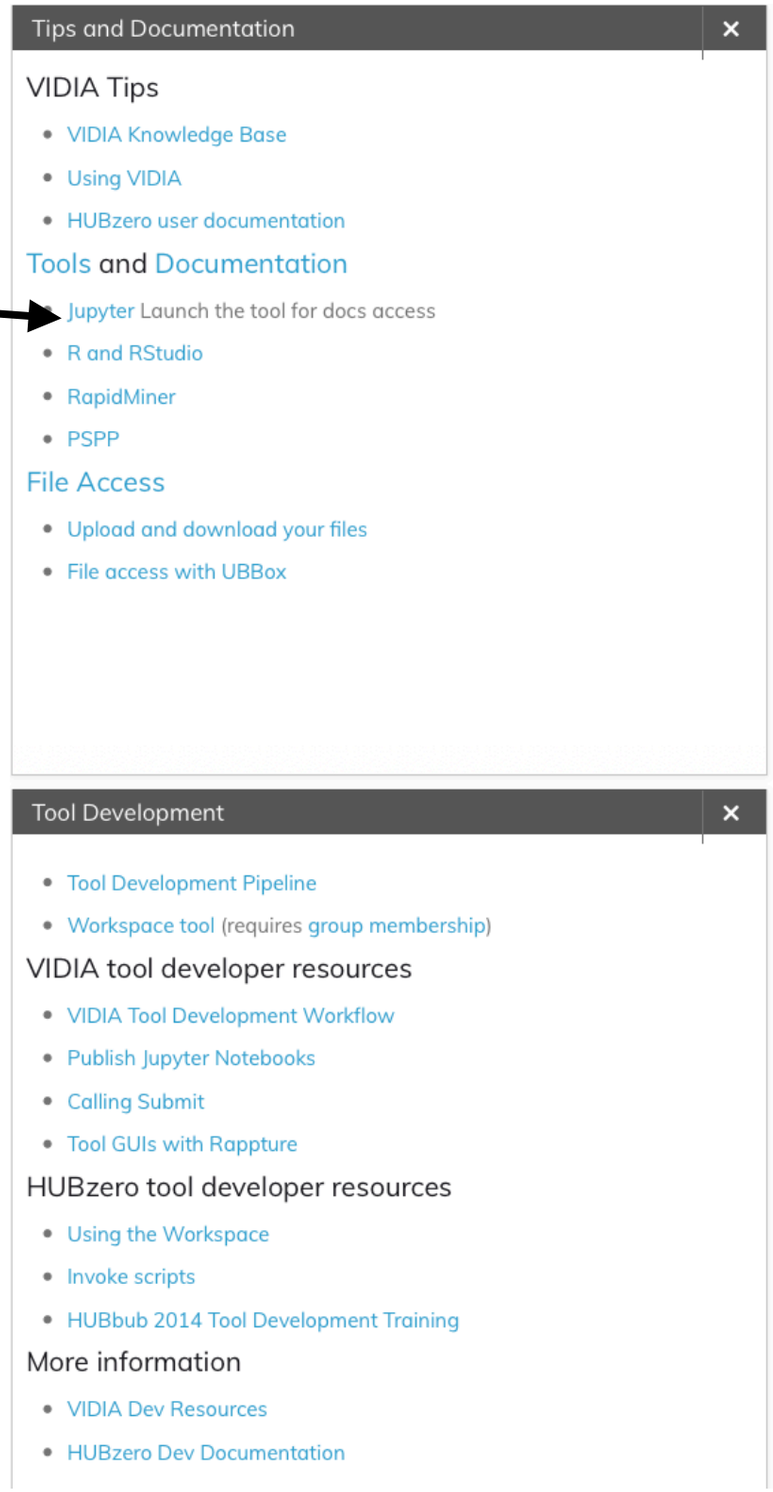
Launch Tool (hard to see)

VIDIA


VIDIA
Discover
Community
About
Support
Salvatore Rocco Rappoccio
srrappoc@buffalo.edu
Search
Exit
Pause
Workspace
Terminate
Keep for later
Color xterm
srrappoc@vidia:~$
Access to menu (including Firefox)
Linux shell
HUB
#1
#2
#3
xterm
12:03 Aug 22
Storage (manage)
5% of 0.9GB
800 x 600

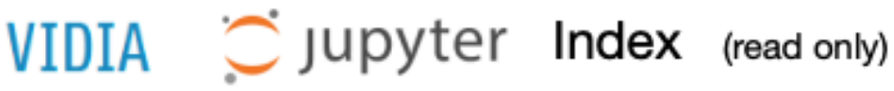
VIDIA : Jupyter

Jupyter notebooks



Jupyter

- Can also use Jupyter notebooks
- Also can be installed on your own machines if you want
- Nice little package for code and documentation at once

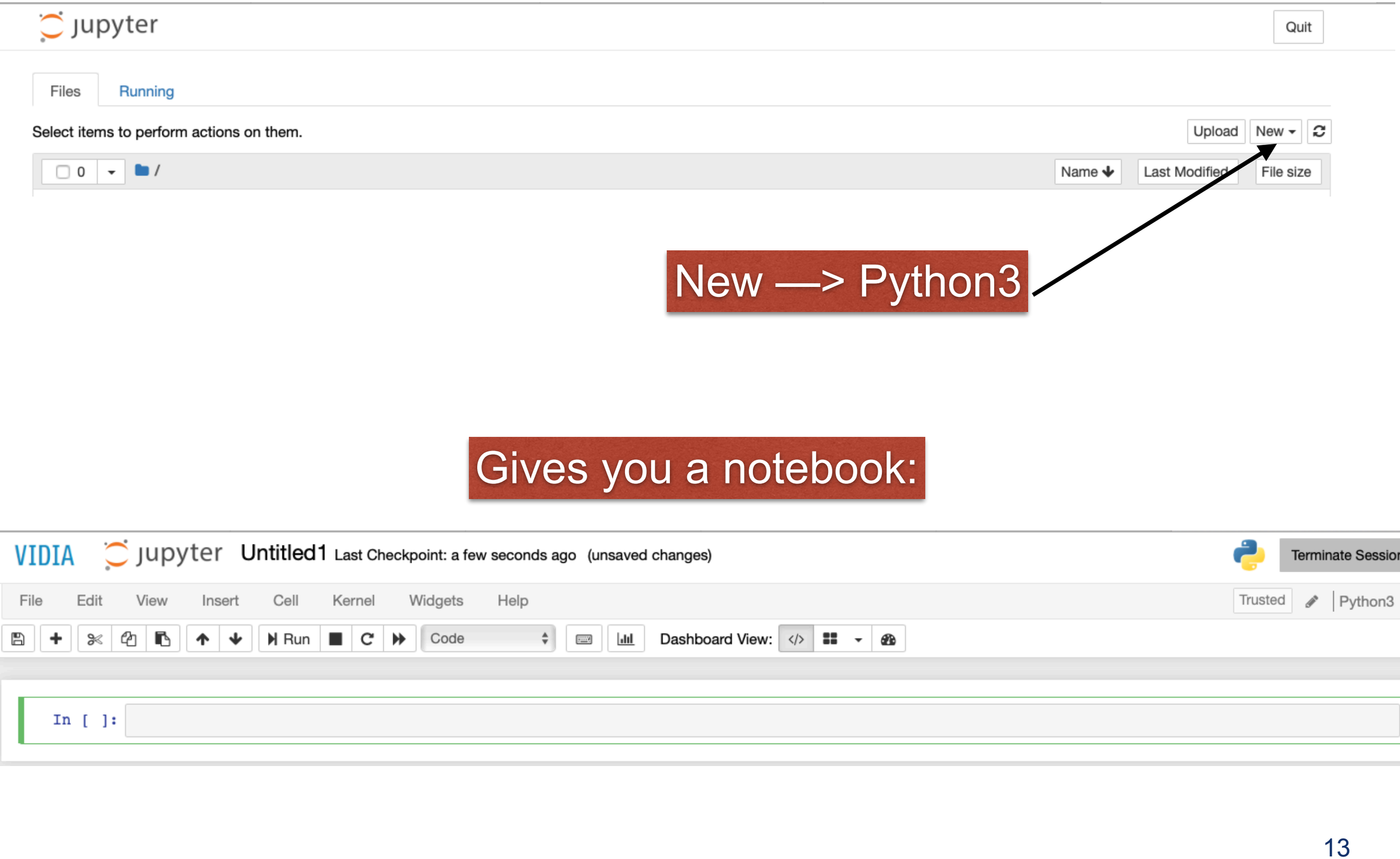


Click Here to go to your Home Directory

READ THIS: IMPORTANT CHANGES

You Are Running Jupyter 5.1

Jupyter



Gives you a notebook:

Jupyter

jupyter Untitled1 Last Checkpoint: 3 minutes ago (unsaved changes)

File Edit View Insert Cell Kernel Widgets Help Python2

Code CellToolbar Dashboard View:

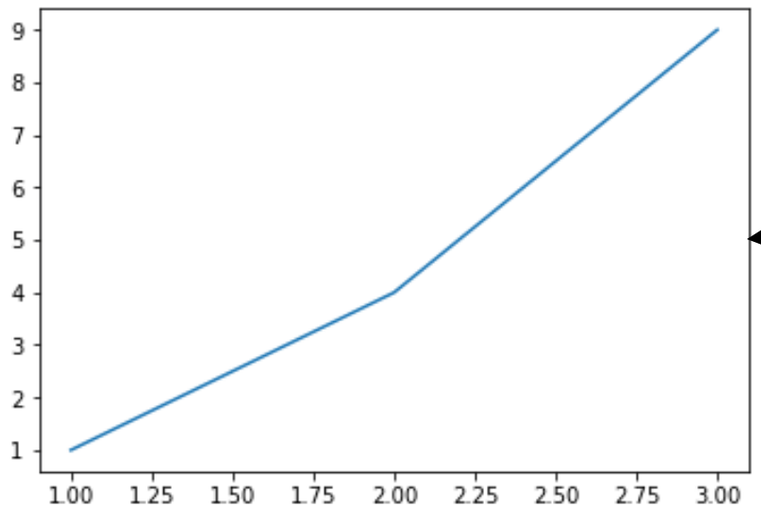
In [3]:
```
import matplotlib
import matplotlib.pyplot as plt
import array

x = array.array('f', [1,2,3])
y = array.array('f', [1,4,9])

plt.plot(x,y)

plt.show()
```

Type python



Shift+Enter: It executes

In [ ]:

Jupyter

jupyter Untitled1 Last Checkpoint: 37 minutes ago (unsaved changes)

File Edit View Insert Cell Kernel Widgets Help Python2

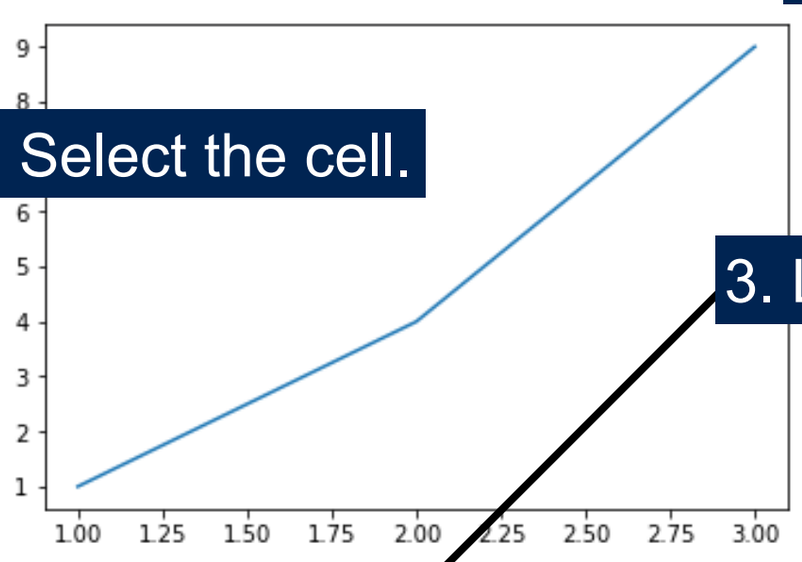
Markdown CellToolbar Dashboard View:

```
In [3]: import matplotlib
        import matplotlib.pyplot as plt
        import array

        x = array.array('f', [1,2,3])
        y = array.array('f', [1,4,9])

        plt.plot(x,y)

        plt.show()
```



2. Change cell to “Markdown”

1. Select the cell.

3. LaTeX goes in “$(stuff here)$”

```
This is a markdown cell.

You can use $\LaTeX$ like this : $y = x^2$. Note of caution: it uses Mathjax, so not
everything is supported.
```

Jupyter

jupyter Untitled1 Last Checkpoint: 37 minutes ago (unsaved changes)

File Edit View Insert Cell Kernel Widgets Help Python2

Markdown CellToolbar Dashboard View:

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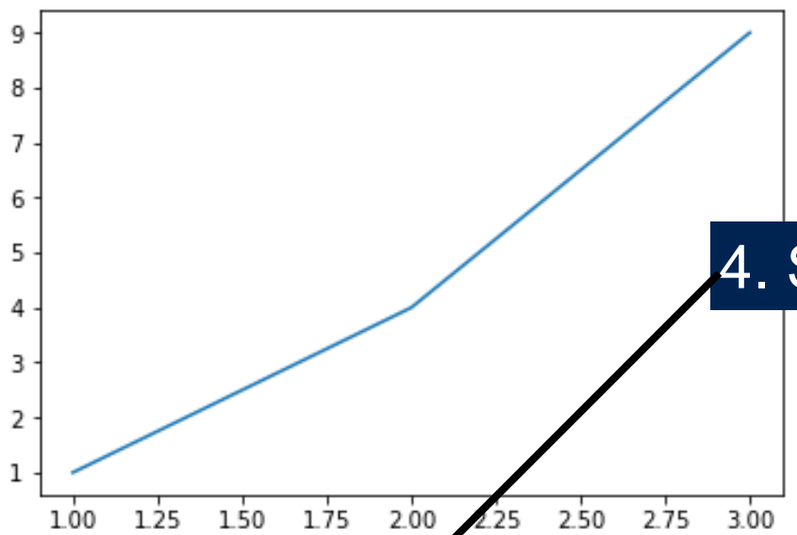
y = array.array('f', [1,4,9])

plt.plot(x,y)

plt.show()
```



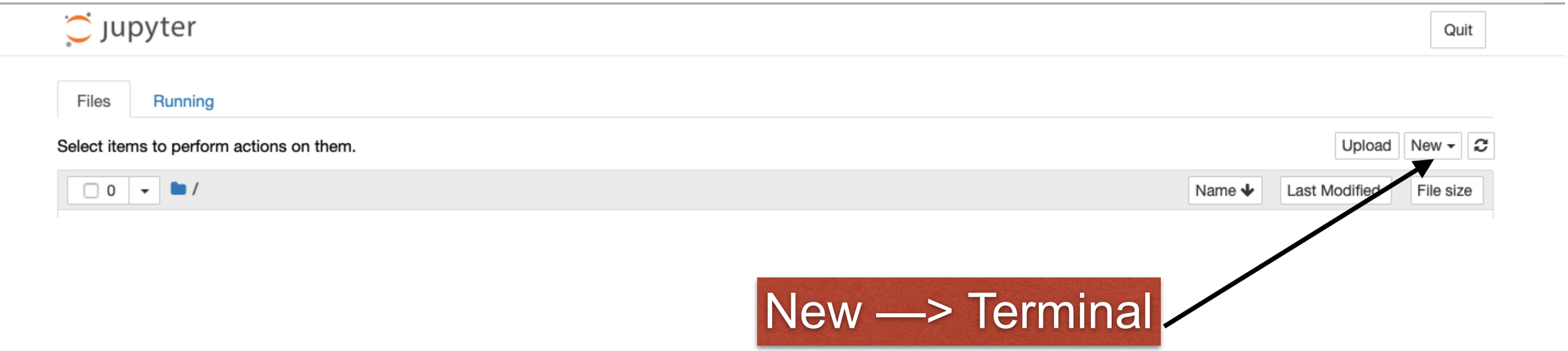
4. Shift+Click, and you get the markdown

This is a markdown cell.

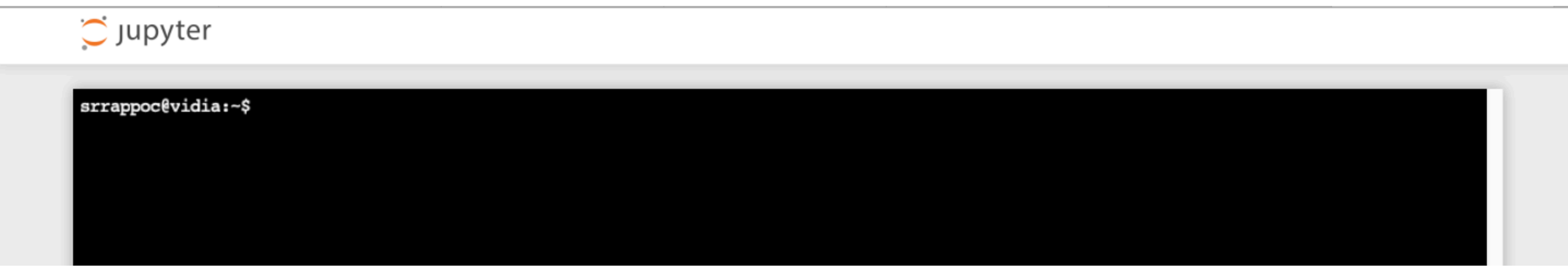
You can use $\LaTeX$ like this : $y = x^2$. Note of caution: it uses Mathjax, so not everything is supported.

Jupyter

- But wait, it gets better! If you want, you can use the Jupyter terminal directly instead of the linux shell.



Gives you:



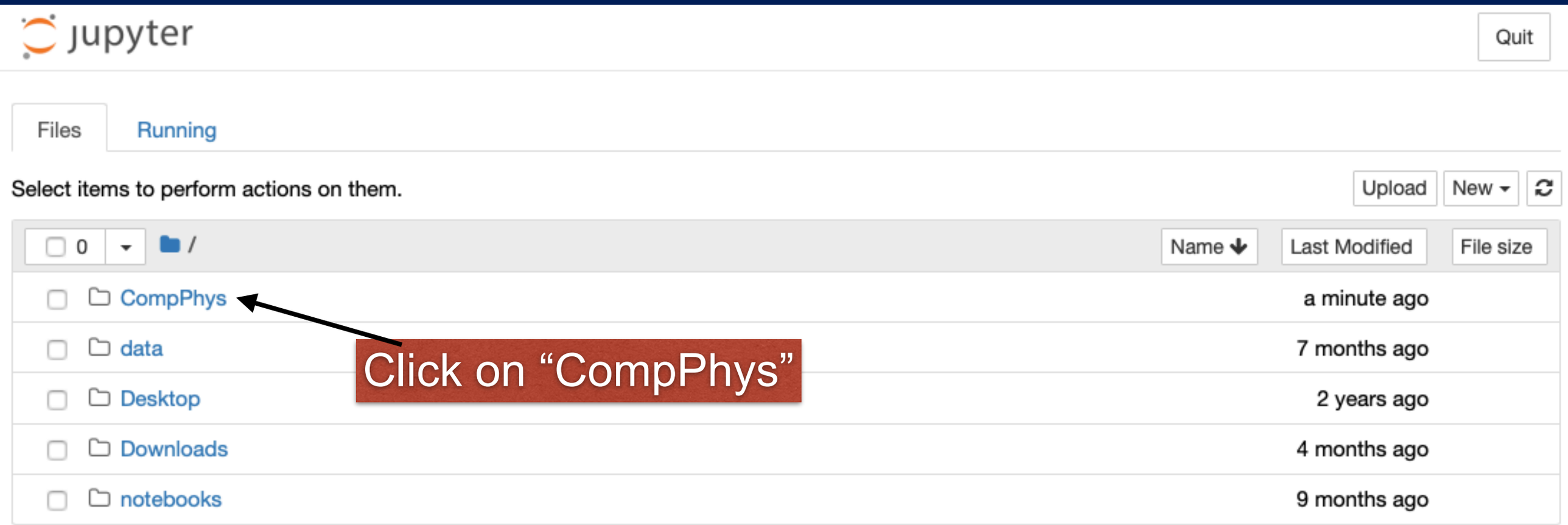
Jupyter

- But wait, it gets better! If you want, you can use the Jupyter terminal directly instead of the linux shell.
- Can get the code for the class directly!

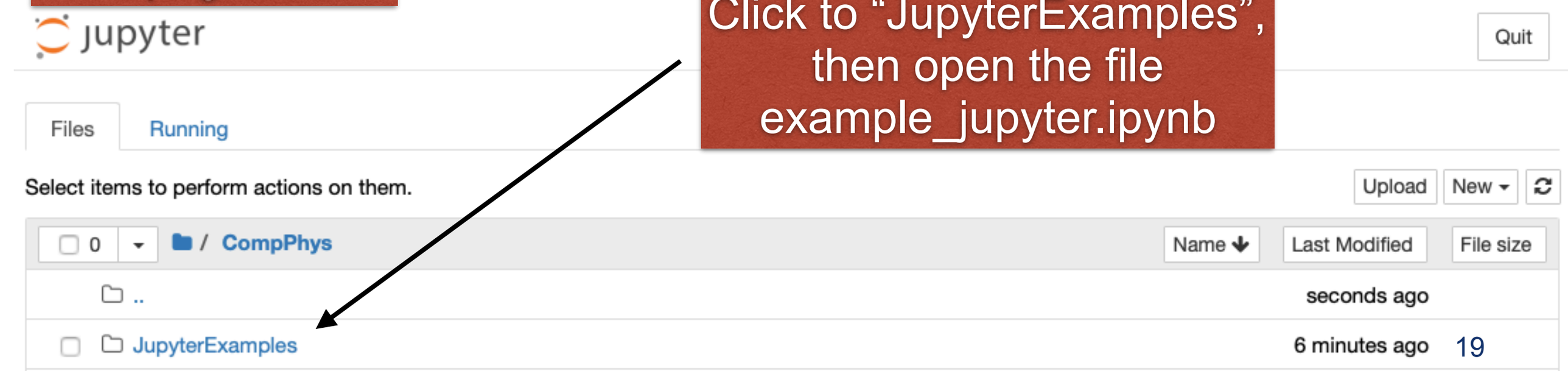
jupyter

```
srrappoc@vidia:~$ git clone https://github.com/rappoccio/CompPhys.git
Cloning into 'CompPhys'...
remote: Enumerating objects: 56, done.
remote: Counting objects: 100% (56/56), done.
remote: Compressing objects: 100% (50/50), done.
remote: Total 56 (delta 3), reused 56 (delta 3), pack-reused 0
Unpacking objects: 100% (56/56), done.
Checking connectivity... done.
srrappoc@vidia:~$
```

Jupyter



Next page is this:



Jupyter

VIDIA jupyter example_jupyter (autosaved) Terminate Session

File Edit View Insert Cell Kernel Widgets Help Trusted Python3

Run Code Dashboard View:

Example using Jupyter

We will generate linear data with Gaussian noise and fit it to a straight line.

First, we import the libraries.

In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
```

Next, we create some simple x and y data from a linear model with some small Gaussian noise.

In [2]:
```
N=100
x = np.linspace(0,10,101)
y = np.random.normal(scale=1,loc=x)

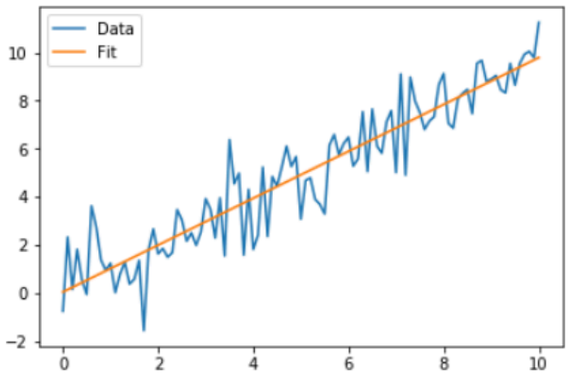
p, residuals, _, _, _ = np.polyfit(x, y, 1, full=True)
chisq_dof = residuals / (len(x) - 2)

print ('Fit results: y = %3.2f x + %3.2f' % (p[0], p[1]) )
```

```
Fit results: y = 0.98 x + 0.04
```

Finally, we plot the results.

In [3]:
```
yfit =  p[0] * x + p[1]
plt.plot(x,y, label='Data')
plt.plot(x,yfit, label='Fit')
plt.legend()
plt.show()
```



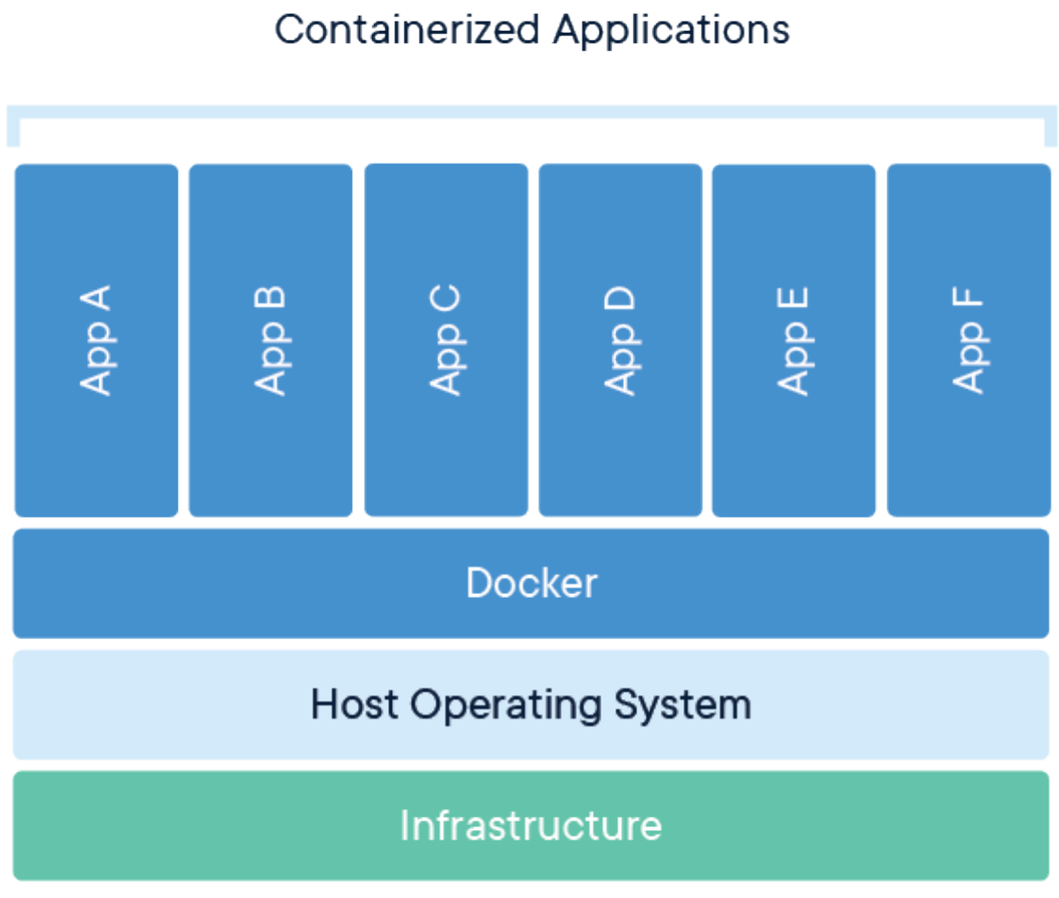
And ta-da! We did a jupyter.

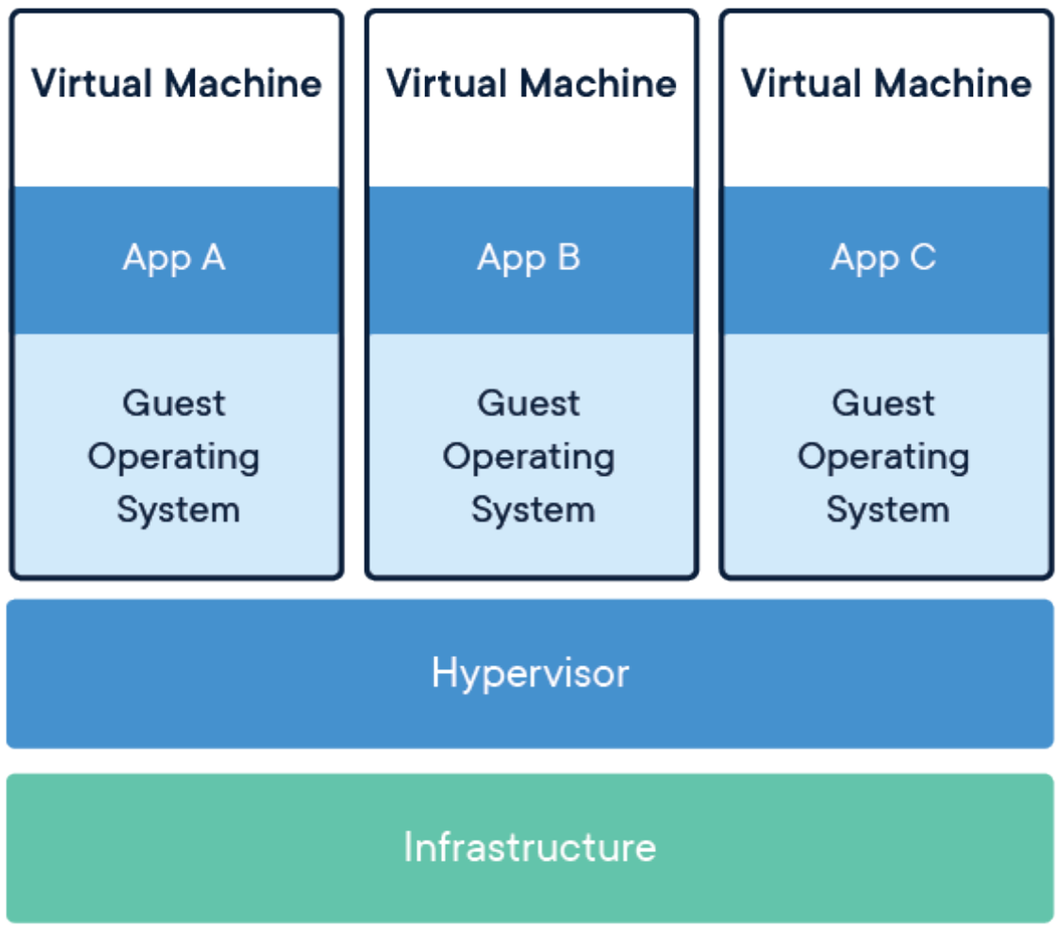
To run:

Kernel:
Restart and Run All

Containers

- Can also make use of containers
  - Virtual “machine” but for applications





Containers

- Why bother?
  - So you don't have to spend time configuring software. It just works.

- Instructions:
  - Get docker : https://docs.docker.com/install/
    - (shortcuts: https://download.docker.com)
  - Follow installation instructions (OS dependent)
  - Once it is running, open your "Terminal" app in your laptop / host machine, and execute these:

```
mkdir results
git clone https://github.com/rappoccio/CompPhys.git
cd CompPhys
./runDocker.sh srappoccio/compphys:latest 1
```

Containers

- You will get a command line just like a linux computer (running Ubuntu 19)

```
% ./runDocker.sh srappoccio/compphys:latest 1
192.168.1.231 being added to access control list
compphys@55d39ad05e02:~$
```

- (Your IP and hash details will be different)

Containers

- There is also a jupyter mode you can run on your own machine:

```
./runDocker.sh srappoccio/compphys:latest 0
```

Last changed to “zero”

```
192.168.1.231 being added to access control list
[I 16:20:12.031 NotebookApp] Writing notebook server cookie secret to /results/.local/share/jupyter/runtime/
notebook_cookie_secret
[I 16:20:12.446 NotebookApp] Loading IPython parallel extension
[I 16:20:12.447 NotebookApp] Serving notebooks from local directory: /results
[I 16:20:12.447 NotebookApp] The Jupyter Notebook is running at:
[I 16:20:12.448 NotebookApp] http://(6209865d7dfc or 127.0.0.1):8888/?
token=d1935c176ba256ed464e8f7bdb2e76fa516bb1044c8c7128
[I 16:20:12.448 NotebookApp] Use Control-C to stop this server and shut down all kernels (twice to skip confirmation).
[W 16:20:12.466 NotebookApp] No web browser found: could not locate runnable browser.
[C 16:20:12.466 NotebookApp]

    To access the notebook, open this file in a browser:
        file:///results/.local/share/jupyter/runtime/nbserver-1-open.html
    Or copy and paste one of these URLs:
        http://(6209865d7dfc or 127.0.0.1):8888/?token=d1935c176ba256ed464e8f7bdb2e76fa516bb1044c8c7128
```

This is your token

Containers

- Now you're running jupyter locally:

UNIX/LINUX

- Operating systems (like Windows or Mac OS)

- We will be using LINUX (an offshoot of UNIX)
  - Invented by Linus Torvalds in 1991
  - Mac OS X is built upon LINUX
- EdX course from the creator here :
  - https://www.edx.org/course/introduction-linux-linuxfoundationx-lfs101x-0#!
- Linux is completely open source : you can modify it at your will and debuggers are also free

- Predominantly command line tools

- Cheat sheet on UBLearns (or indico for FNAL people)

Linux Shells

- We will be using an interface to Linux called a “shell”
- It is a command-line interpreter : you type, it executes

- Two major options are “bash” (as in, smash) and “csh” (like “sea shell”, modern version is “tcsh”, “tea sea shell”)
- For the most part, few differences with respect to this class, you can use either one.

- Major difference : environment variables syntax
  - bash: export X=value
  - tcsh: setenv X value
- That’s about it for the purposes of this class

Linux Command Line

- Basics : Listing directory contents : “ls”, like “list”

```
$ ls
$
```

  - Empty right now

- Basics : Echoing content : “echo” :

```
$ echo "Why am I here?"
Why am I here?
```

- Basics : Saving what you type: the “pipe” command : “>”

```
$ echo "Who am I?" > stuff.txt
$ echo “Why am I here?” > stuffagain.txt
```

- No output… what happened? “ls” again:

```
$ ls
stuff.txt stuffagain.txt
```

- Aha, there it is. What’s in it?

Linux Command Line

- Reading files : “more”, “less”, and “cat”:
  - “cat” : concatenates files together (if just one, reads it)

```
$ cat stuff.txt
Who am I?
```

  - “less”: reads a file and paginates it

```
$ less stuff.txt
Who am I?
~
```

  - “more” : reads multiple files separately

```
$ more stuff.txt
Who am I?
```

Linux Command Line

– “cat” will concatenate:

```
$ cat stuff.txt stuffagain.txt
Who am I?
Why am I here?
```

– But “more” does more:

```
$ more stuff.txt stuffagain.txt
::::::::::::::
stuff.txt
::::::::::::::
Who am I?
::::::::::::::
stuffagain.txt
::::::::::::::
Why am I here?
$
```

Linux Command Line

- What if you want to copy or move files?
- Copy : “cp” :

```
$ cp stuff.txt stuff1.txt
$ ls
stuff1.txt  stuffagain.txt  stuff.txt
$ cat stuff1.txt
Who am I?
```

  - File “stuff1.txt” is a copy of “stuff.txt”
  - They are duplicates. “stuff.txt” is retained.

- Move : “mv” :

```
$ ls
stuff2.txt  stuffagain.txt  stuff.txt
$ cat stuff2.txt
Who am I?
```

  - File “stuff2.txt” is there, but “stuff1.txt” is gone
  - Also known as “renaming”!

Linux Command Line

- Removing files : “rm”

```
$ rm stuff2.txt
rm: remove regular file `stuff2.txt'? y
$ ls
stuffagain.txt  stuff.txt
```

  - Gone forever. Really, really, really gone. No “trash bin”. No “restore”. No “but professor, can’t I undo that?” No. You cannot. Bits are gone.

- Backups in LINUX are VERY IMPORTANT TO HAVE

  - Example:

```
$ cp stuff.txt stuff_backup_27jan2017.txt
```

  - OR! Use version control (more on that later)

Linux Command Line

- What if I hate typing files one at a time?
  - Then Linux is the best operating system for you

- Huge number of shortcuts in LINUX :
  - tab completion : If you start typing and press “TAB”, it will list the possible completions, or if there is only one, complete it for you
  - “up” key : reproduces previous line in Terminal
  - aliases : can define your own shortcuts

  - wildcards!

Hands on!

- Open terminal, go to “CompPhys/LinuxOverview”
- Look at “commandline1.sh” file:

```
% more commandline1.sh
echo "Always look on the bright side of life" > bright.txt
echo "If life is jolly rotten, there's something you've
forgotten" > forgotten.txt
cat bright.txt forgotten.txt > song.txt
cat song.txt=
```

- Execute:

```
% bash commandline1.sh
```

- Output:

```
Always look on the bright side of life
If life is jolly rotten, there's something you've forgotten
```

- Type “ls”:

```
bright.txt commandline1.sh forgotten.txt song.txt
```

- Demonstrates: more, ls, and cat commands, files, and piping

Linux Command Line

- Wildcards : http://www.tldp.org/LDP/GNU-Linux-Tools-Summary/html/x11655.htm

– ? : single character

```
$ ls ?right.txt
bright.txt
```

– * : any number of characters

```
$ ls *.txt
bright.txt  forgotten.txt  song.txt  stuffagain.txt
stuff_backup_27jan2017.txt  stuff.txt
```

```
$ ls s*.txt
song.txt  stuffagain.txt  stuff_backup_27jan2017.txt  stuff.txt
```

Linux Command Line

- Wildcards:

– [] : specifies a range

```
$ echo "song1" > song1.txt
$ echo "song2" > song2.txt
$ echo "song3" > song3.txt
$ cat song[1-2].txt
song1
song2
```

– {} : name or wildcard

```
$ echo "song4" > whoops.ugh
$ cat {song*.txt,whoops.ugh}
song1
song2
song3
Always look on the bright side of life
If life is jolly rotten, there's something you've forgotten
song4
```

Linux Command Line

- Command line options :
  - What if you like “rm”, but hate to confirm each removal?
  - “rm” has OPTIONS you can add
- Options usually come in two forms :
  - Single dash, single letter : “ls -r”
  - Two dashes, many letters: “ls —help”
  - Most commands come with “—help”, so you can read the options you have

Linux Command Line

- Example : “ls”:

```
$ ls --help
Usage: ls [OPTION]... [FILE]...
List information about the FILEs (the current directory by default).
Sort entries alphabetically if none of -cftuvSUX nor --sort.

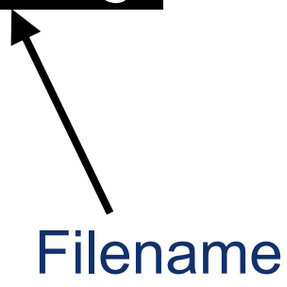
Mandatory arguments to long options are mandatory for short options too.
  -a, --all                  do not ignore entries starting with .
  -A, --almost-all           do not list implied . and ..
      --author               with -l, print the author of each file
  -b, --escape               print octal escapes for nongraphic characters
      --block-size=SIZE      use SIZE-byte blocks.  See SIZE format below
```

- Common options
  - “-l” : long listing
  - “-a” : list all
  - “-t” : list by time
  - “-r” reverse

Linux Security

- What the heck is all this stuff?

```
-rw-------  1 srrappoc phyfac    6 Jan 27 11:14 whoops.ugh
```



Linux Security

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-rw-------  1 srrappoc phyfac    6 Jan 27 11:14 whoops.ugh
```

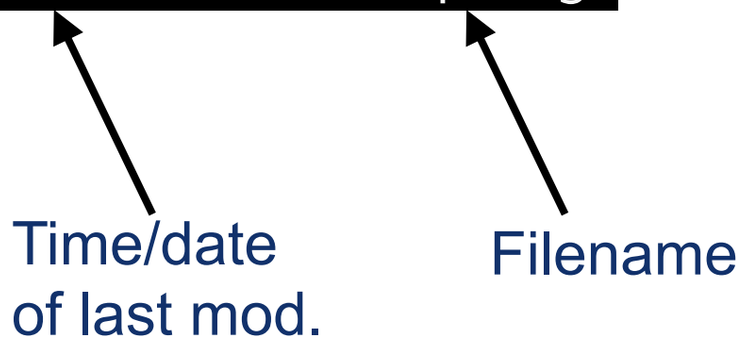

Linux Security

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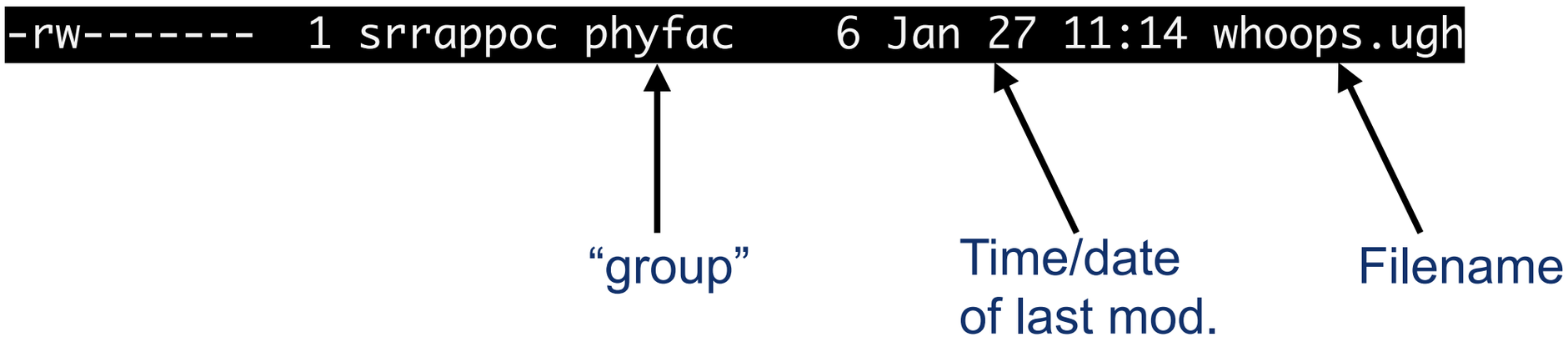

Linux Security

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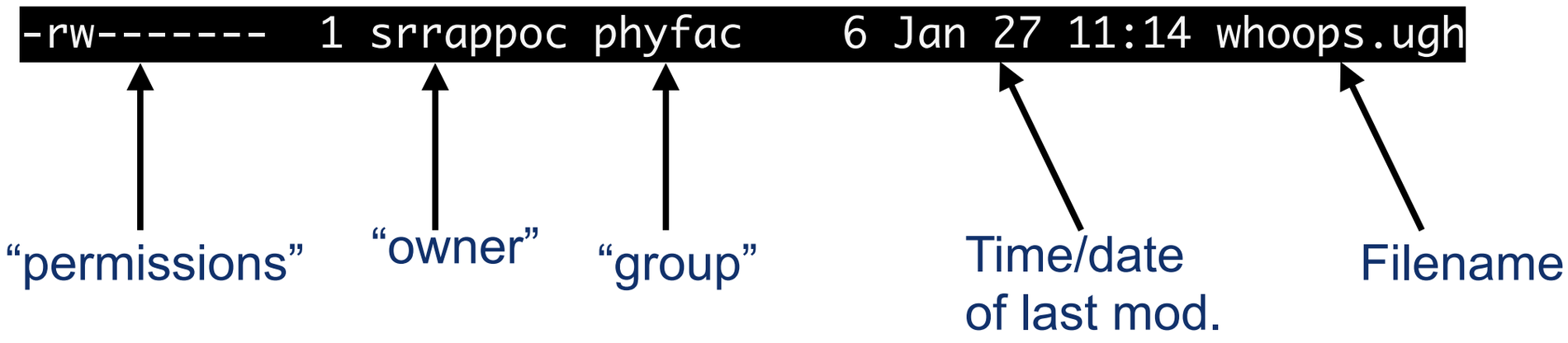


Linux Security

- Levels of security :
  - All : everyone
  - Group : a group of users
  - Owner : the owner of the file

- Access levels :
  - Read : Can read from file
  - Write : Can write to file
  - Execute : Can execute if it is a program

- Can set different access levels for different levels
  - Most common example: “Owner” can read+write, “Group” can read, “All” can do nothing

Linux Security

- You can change the permissions, the owners, or the groups of files:

  - chown (change owner or group) :
    - usage : chown user:group file
    - change owner of file to “user” and group to “group”
  - chmod (change permission)
    - usage examples :
      - chmod a+x file (give execute permission to “all”)
      - chmod g+w file (give write permission to “group”)
      - chmod a+wrx file (give read/write/execute permission to anyone)

Linux Directories

- To make directories, use “mkdir”:

```
$ mkdir testdir
$ ls
bright.txt  commandline1.sh   forgotten.txt   song.txt    testdir
```

  - To remove them, “rmdir” (must be empty)

- You can move files from one directory to another with “mv” just like before:

```
$ mv song.txt testdir/
```

- And you can use “ls” to look at the directory:

```
$ ls testdir/
song.txt
```

Linux Directories

- The directory you are “in” is called the “current directory”
- To change your current directory, use “cd”:

```
$ cd testdir
/nsm/home/srrappoc/testdir
$ ls
song.txt
```

- To go to the directory “up” the chain, do “cd ..”:

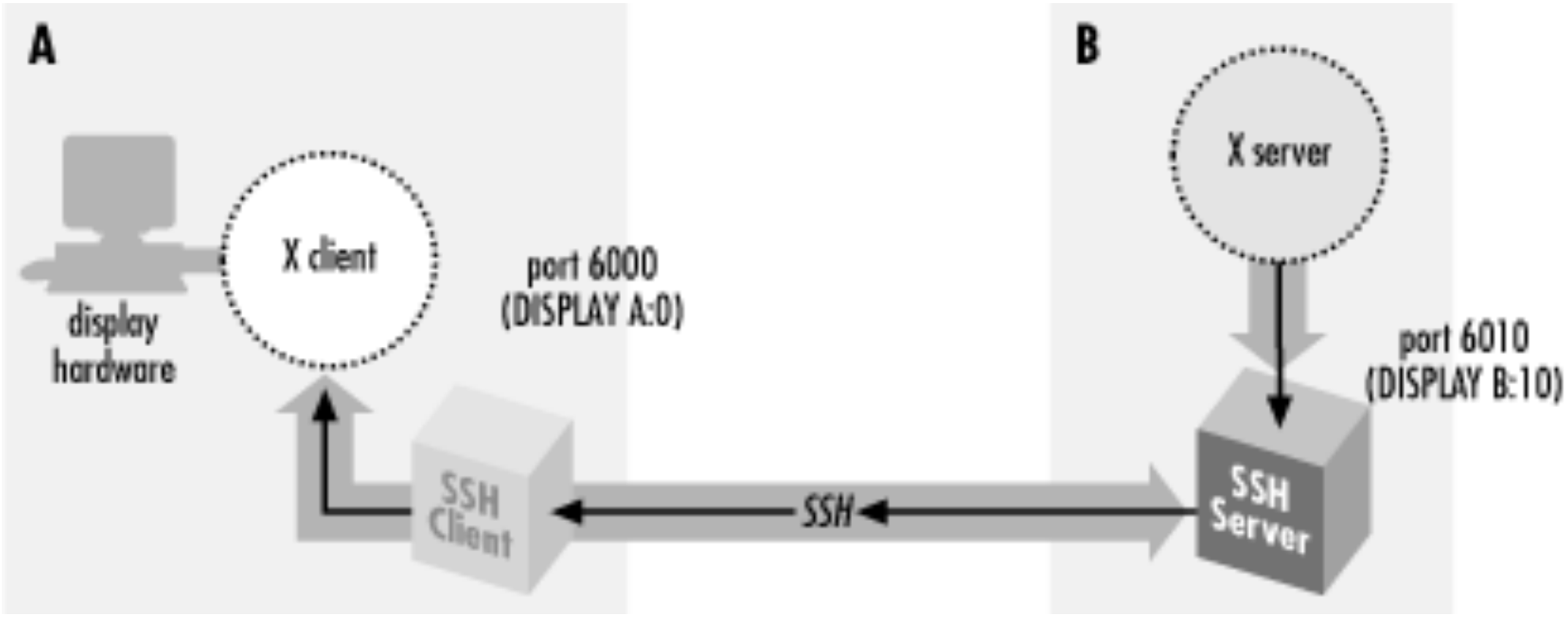
```
$ cd ..
```

- There are shortcuts for “cd” :
  - “cd -“ go to previous directory
  - “cd” (no arguments) go to home directory

- You can also print the working directory (pwd)

Editors

- AKA : why is it so f*ing hard to type stuff in Linux?
  - It isn't, you're just not thinking about it right :)
  - If you're sitting at the same terminal you're executing commands on, your server is the same as your client
  - If you're using ssh, you are trying to send a ton of graphical information over the net to type



Editors

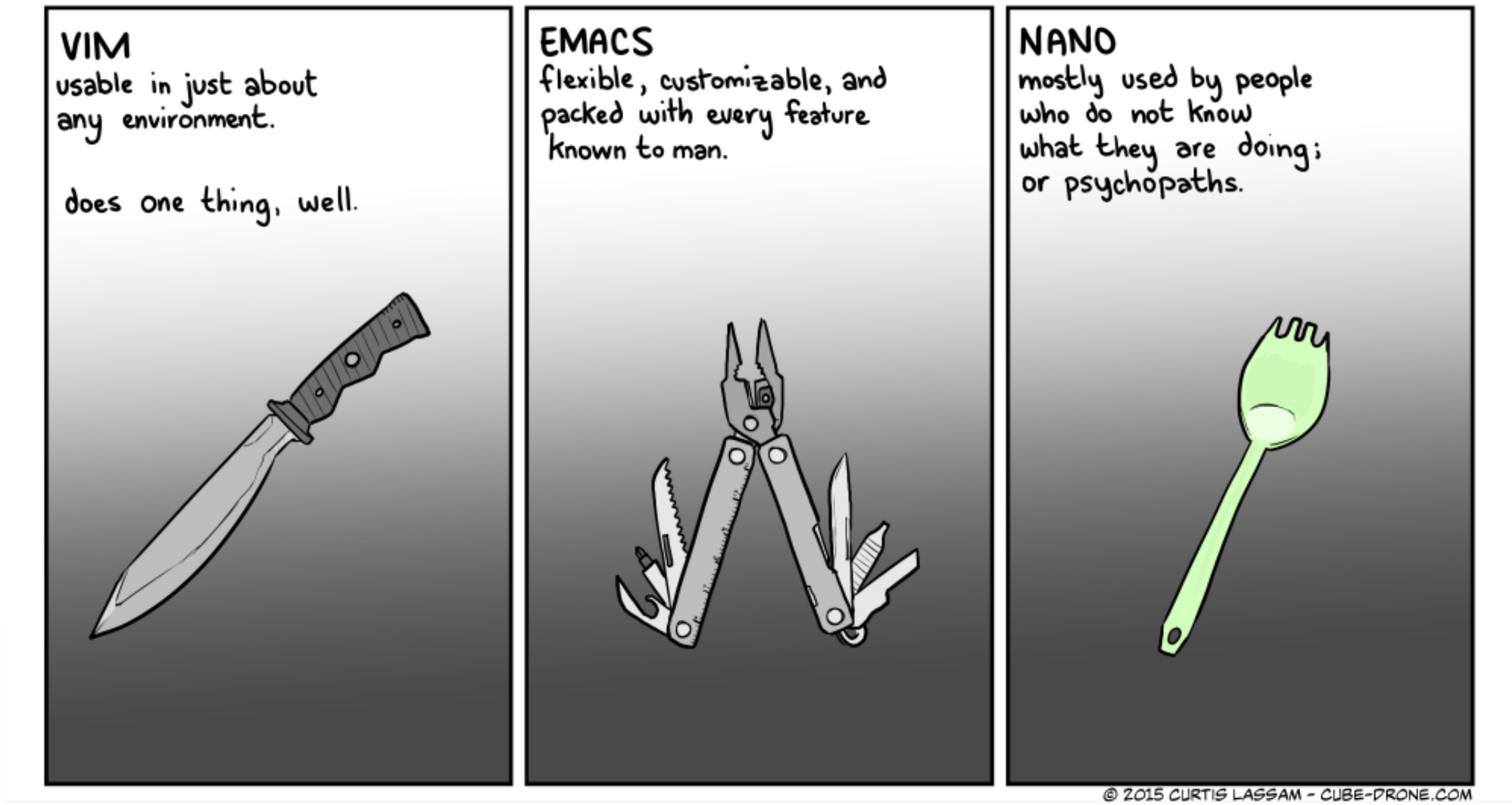
- Linux comes with the “X11” graphics package : that’s how everything works
  - This is also the basis for Mac OS’s GUI

- Many editors are available, and many have “inline text” and “X11” modes

- Now we come to one of the greatest scientific controversies of all time:

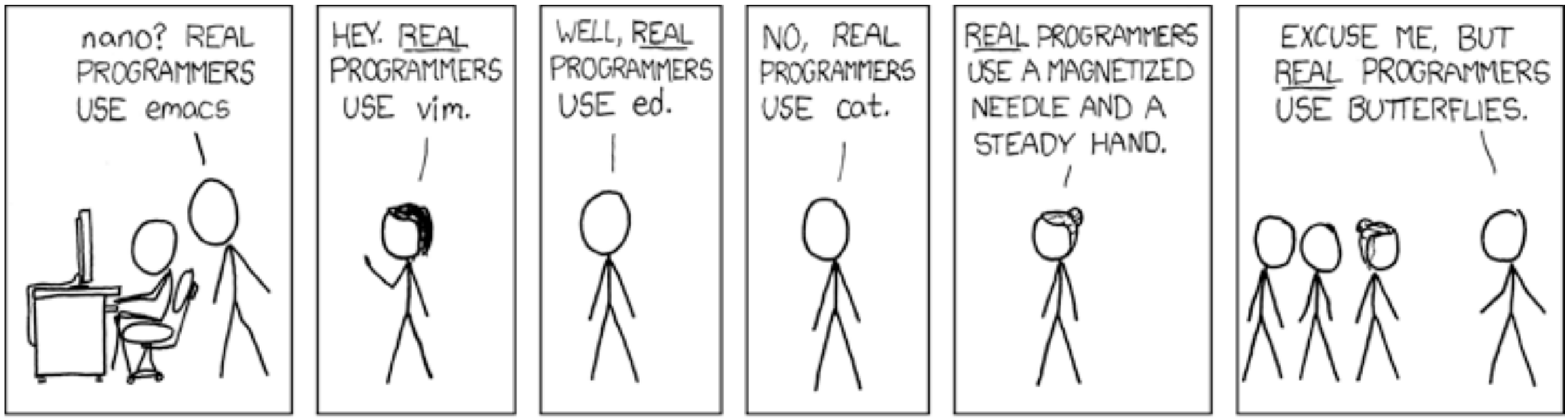
THE EDITOR WARS

Editors



http://cube-drone.com/comics/c/holy-war

Editors


nano? REAL PROGRAMMERS USE emacs
HEY. REAL PROGRAMMERS USE vim.
WELL, REAL PROGRAMMERS USE ed.
NO, REAL PROGRAMMERS USE cat.
REAL PROGRAMMERS USE A MAGNETIZED NEEDLE AND A STEADY HAND.
EXCUSE ME, BUT REAL PROGRAMMERS USE BUTTERFLIES.
THEY OPEN THEIR HANDS AND LET THE DELICATE WINGS FLAP ONCE.
THE DISTURBANCE RIPPLES OUTWARD, CHANGING THE FLOW OF THE EDDY CURRENTS IN THE UPPER ATMOSPHERE.
THESE CAUSE MOMENTARY POCKETS OF HIGHER-PRESSURE AIR TO FORM,
WHICH ACT AS LENSES THAT DEFLECT INCOMING COSMIC RAYS, FOCUSING THEM TO STRIKE THE DRIVE PLATTER AND FLIP THE DESIRED BIT.
NICE.
'COURSE, THERE'S AN EMACS COMMAND TO DO THAT.
OH YEAH! GOOD OL' C-x M-c M-butterfly...
DAMMIT, EMACS.

Editors

- I am personally firmly in the “Emacs” zone of the world
- If you are a vi or ed user, you can leave now
  - Kidding!!! *coughsortofcough*

- I can teach you the basics of emacs, and you should learn the rest on your own. You’re scientists, that’s how it goes. It’s like learning to walk, or ride a bike, or hazing or something.

Editors

- emacs :
  - X mode : emacs filename.txt &
    - Edit away as you want.
  - Terminal mode : emacs -nw filename.txt
    - “-nw” is “no window”
  - Tutorial : https://www.gnu.org/software/emacs/tour/
- vi / vim:
  - vi filename.txt
  - I suck at vi, so just go here:
    - https://scotch.io/tutorials/getting-started-with-vim-an-interactive-guide

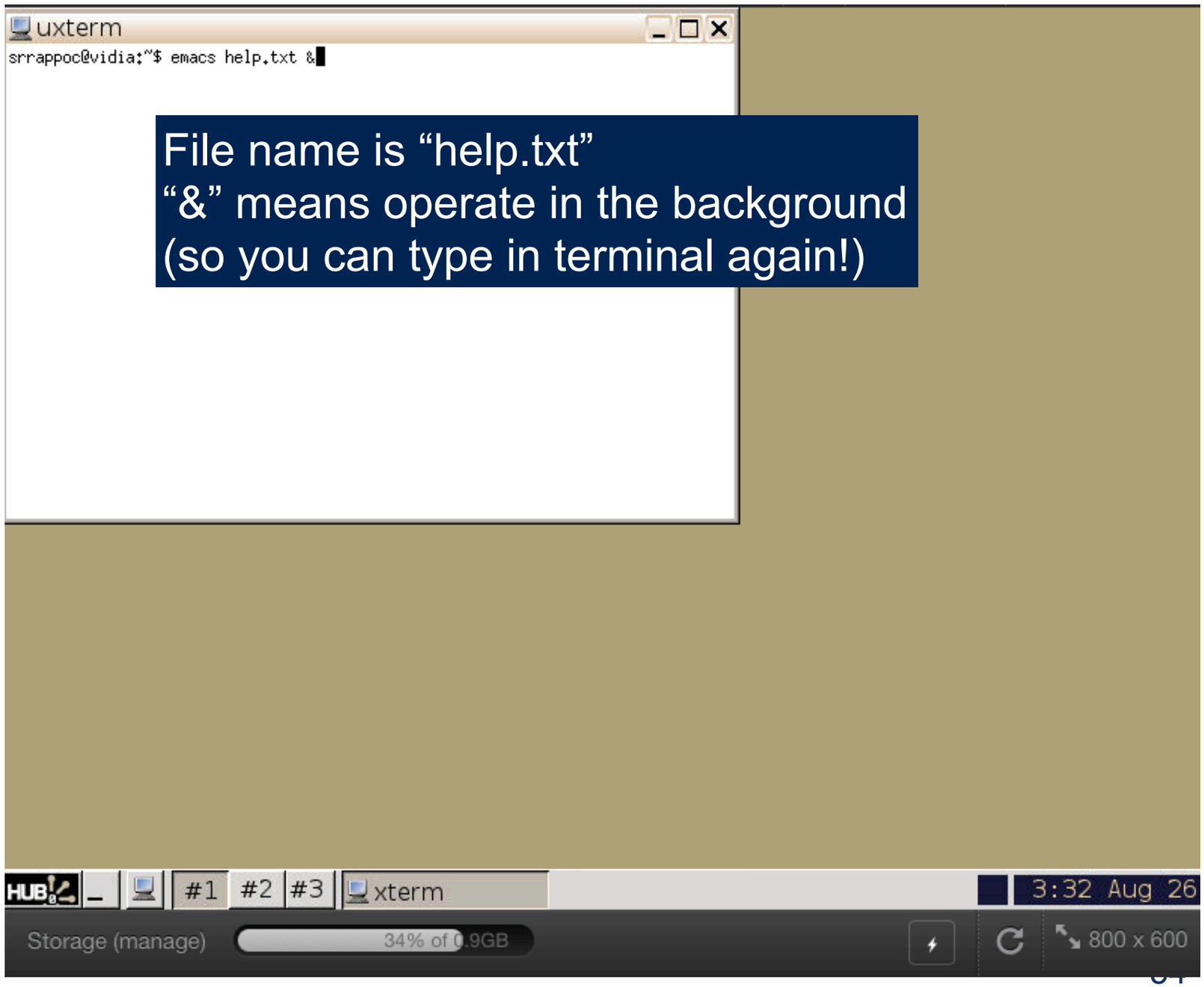
Editors

- If you're terrified of learning how to use these, just use "nano". The interface is straightforward, but has extremely few features.

- Some of you young whipper snappers will want to use a more modern editor like sublime or xcode
  - If you know out how to use them, go for it, but I won't help you! :)

Editing: VIDIA

- Emacs and vi are installed in vidia
- You can also just use jupyter directly and type there
- Example:



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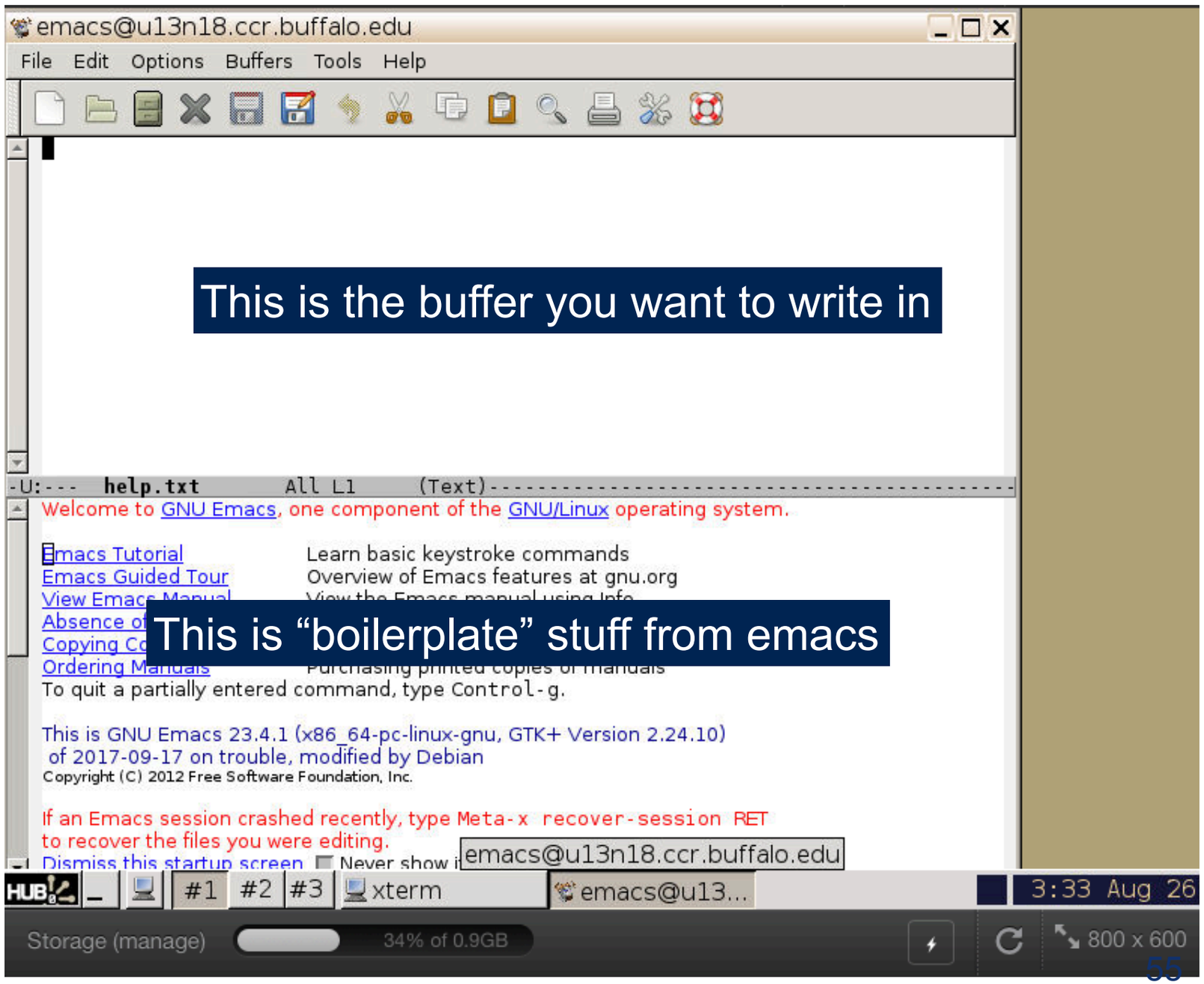
- Example:



Editing: VIDIA

- Emacs and vi are installed in vidia
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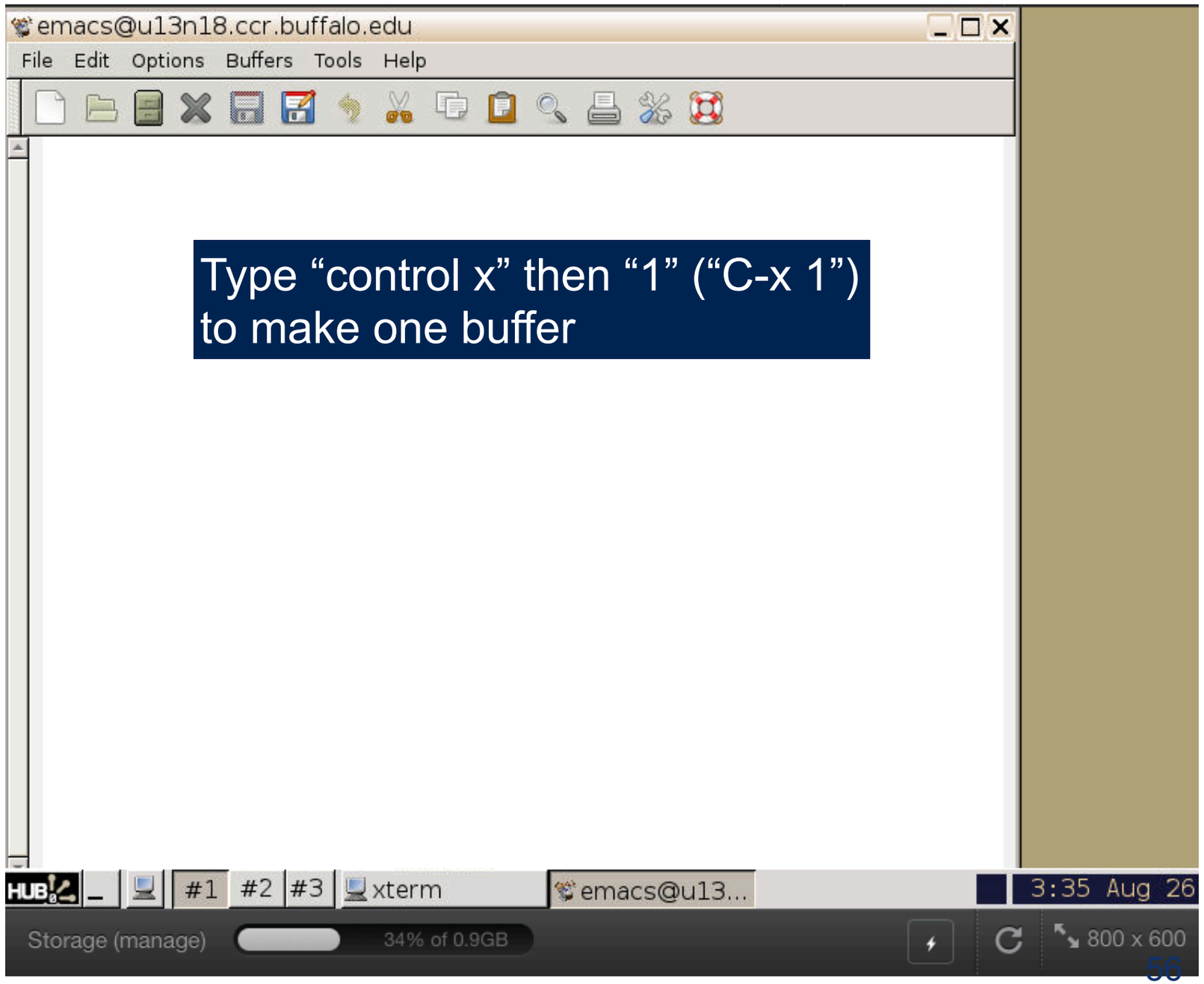
- Example:



Editing: VIDIA

- Emacs and vi are installed in vidia
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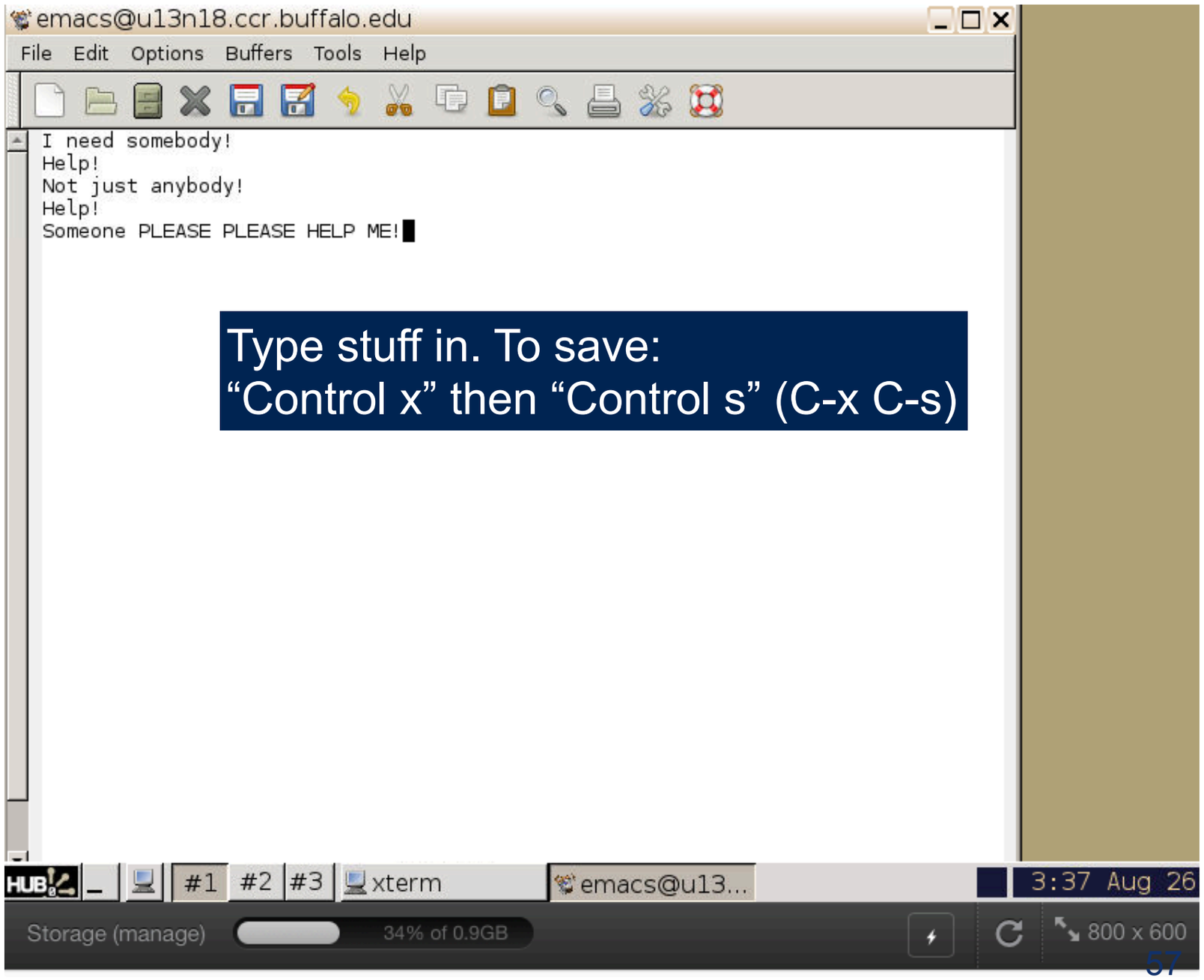
- Example:

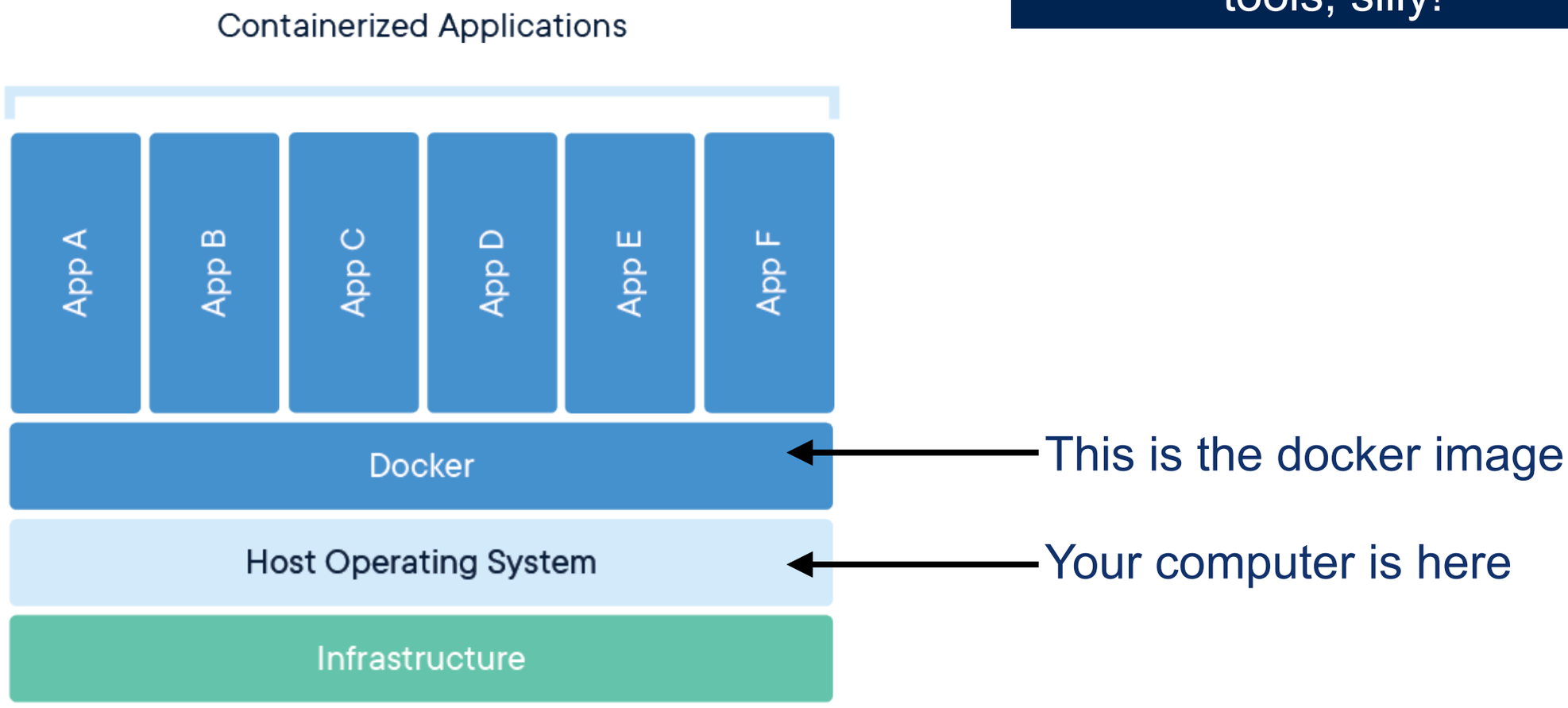


Editing: Docker

- There is no emacs in our docker image
- There is no vi in our docker image
- There is no editor at all

- WTH Sal?!!?

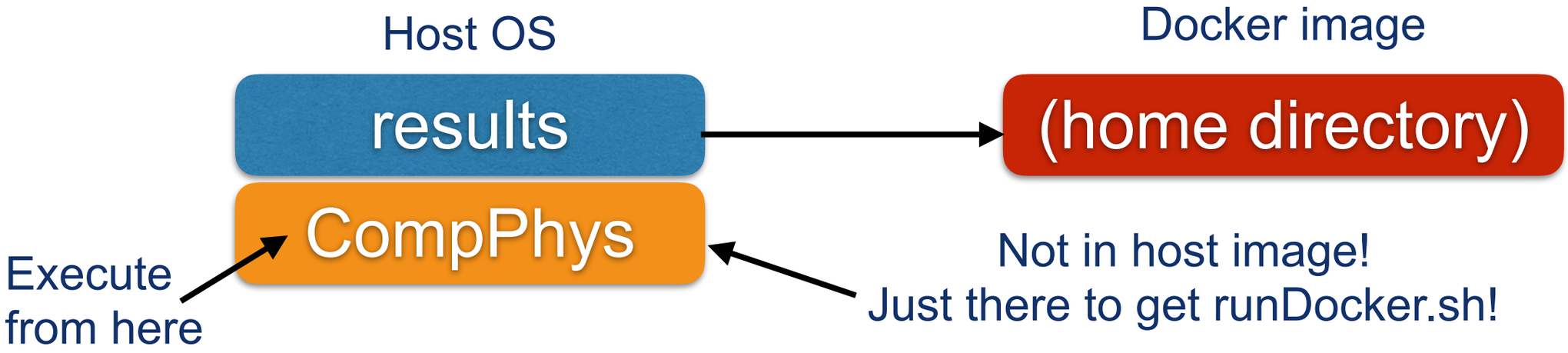
Use the host operating system's editing tools, silly!



Editing: Docker

- Remember the instructions? That little first line to make a "results" directory?

```
mkdir results
git clone https://github.com/rappoccio/CompPhys.git
cd CompPhys
./runDocker.sh srappoccio/compphys:latest 1
```



The Docker instance is transient!
Stuff in "home" directory
(aka "results" in your host OS)
are saved

Docker setup

```
[galadriel:% mkdir results
[galadriel:% git clone https://github.com/rappoccio/CompPhys.git
Cloning into 'CompPhys'...
remote: Enumerating objects: 196, done.
remote: Counting objects: 100% (196/196), done.
remote: Compressing objects: 100% (146/146), done.
remote: Total 196 (delta 66), reused 172 (delta 43), pack-reused 0
Receiving objects: 100% (196/196), 535.99 KiB | 9.75 MiB/s, done.
Resolving deltas: 100% (66/66), done.
[galadriel:% ls
CompPhys        results
[galadriel:% ls *
CompPhys:
AdvCpp                  JupyterExamples         ReviewPython            runDocker.sh
ArrayProgramming        LinuxOverview           SwigExamples
DataAnalysis            README.md               Vectorization
Dockerfile              ReviewCpp               install_software.sh

results:
galadriel:%
```

Docker setup

You type:

```
[galadriel:% mkdir results
[galadriel:% git clone https://github.com/rappoccio/CompPhys.git
Cloning into 'CompPhys'...
remote: Enumerating objects: 196, done.
remote: Counting objects: 100% (196/196), done.
remote: Compressing objects: 100% (146/146), done.
remote: Total 196 (delta 66), reused 172 (delta 43), pack-reused 0
Receiving objects: 100% (196/196), 535.99 KiB | 9.75 MiB/s, done.
Resolving deltas: 100% (66/66), done.
[galadriel:% ls
CompPhys        results
[galadriel:% ls *
CompPhys:
AdvCpp                  JupyterExamples         ReviewPython            runDocker.sh
ArrayProgramming        LinuxOverview           SwigExamples
DataAnalysis            README.md               Vectorization
Dockerfile              ReviewCpp               install_software.sh

results:
galadriel:%
```

Docker setup

Software downloads:

```
[gala
[gala                              s://github.com/rappoccio/CompPhys.git
Cloning into 'CompPhys'...
remote: Enumerating objects: 196, done.
remote: Counting objects: 100% (196/196), done.
remote: Compressing objects: 100% (146/146), done.
remote: Total 196 (delta 66), reused 172 (delta 43), pack-reused 0
Receiving objects: 100% (196/196), 535.99 KiB | 9.75 MiB/s, done.
Resolving deltas: 100% (66/66), done.
[galadriel:% ls
CompPhys        results
[galadriel:% ls *
CompPhys:
AdvCpp                  JupyterExamples         ReviewPython            runDocker.sh
ArrayProgramming        LinuxOverview           SwigExamples
DataAnalysis            README.md               Vectorization
Dockerfile              ReviewCpp               install_software.sh

results:
galadriel:%
```

Docker setup

```
galadriel:% mkdir results
galadriel:% git clone https://github.com/rappoccio/CompPhys.git
Cloning into 'CompPhys'...
remote: Enumerating objects: 196, done.
remote: Counting objects: 100% (196/196), done.
remote: Compressing objects: 100% (146/146), done.
remote: Total 196 (delta 66), reused 172 (delta 43), pack-reused 0
                                , 535.99 KiB | 9.75 MiB/s, done.
                                one.
```

This is what is in the directories:

```
galadriel:% ls
CompPhys        results
galadriel:% ls *
CompPhys:
AdvCpp                  JupyterExamples         ReviewPython            runDocker.sh
ArrayProgramming        LinuxOverview           SwigExamples
DataAnalysis            README.md               Vectorization
Dockerfile              ReviewCpp               install_software.sh

results:
galadriel:%
```

Docker setup

- Execute the docker command, and the home directory has nothing in it
  - It's the "results" directory so that makes sense:

```
galadriel:% ./runDocker.sh srappoccio/compphys:latest 1
10.84.26.222 being added to access control list
compphys@0a8875f9d03e:~$ ls
compphys@0a8875f9d03e:~$
```

Docker setup

- Now if I want to put something there I can:

```
compphys@0a8875f9d03e:~$ echo "I get by with a little help from my friends" > CockersVersionisBetterSNS.txt
compphys@0a8875f9d03e:~$ ls
CockersVersionisBetterSNS.txt
compphys@0a8875f9d03e:~$ more CockersVersionisBetterSNS.txt
I get by with a little help from my friends
compphys@0a8875f9d03e:~$
```

- It is in the HOME directory on the docker image.
- AND it is in the “results” directory on your host OS:
  - It is NOT in the directory you executed from

```
compphys@0a8875f9d03e:~$ exit
exit
lsgaladriel:% ls
AdvCpp                  Dockerfile              README.md               SwigExamples            runDocker.sh
ArrayProgramming        JupyterExamples         ReviewCpp               Vectorization
DataAnalysis            LinuxOverview           ReviewPython            install_software.sh
galadriel:% ls ../results/
CockersVersionisBetterSNS.txt
galadriel:% more ../results/CockersVersionisBetterSNS.txt
I get by with a little help from my friends
galadriel:%
```

It is NOT here.

It is in “../results”

Editing in Docker

- Now, if you edit the files in the “results” folder they appear in the “home” folder of the docker image:

```
galadriel:% emacs ../results/CockersVersionisBetterSNS.txt
```

```
What would you do if I sang out of tune?
I get by with a little help from my friends
```

```
-uu-:---F1  CockersVersionisBetterSNS.txt    All L1      (Text)---
```

Editing in Docker

- Now, if you edit the files in the “results” folder they appear in the “home” folder of the docker image:

```
galadriel:% ./runDocker.sh srappoccio/compphys:latest 1
10.84.26.222 being added to access control list
compphys@2bc56cef647a:~$ ls
CockersVersionisBetterSNS.txt  CockersVersionisBetterSNS.txt~
compphys@2bc56cef647a:~$ more CockersVersionisBetterSNS.txt
What would you do if I sang out of tune?
I get by with a little help from my friends
compphys@2bc56cef647a:~$
```

ALL NEW DOCKER IMAGE!

“home” folder (“results” from host) now has the updates!

Editing in Docker

- So you just edit in whatever form you want in the “results” folder and they will appear in the docker image in the “home” directory

- You will therefore put your assignments, etc, in the “results” folder and execute them from the “CompPhys” folder!