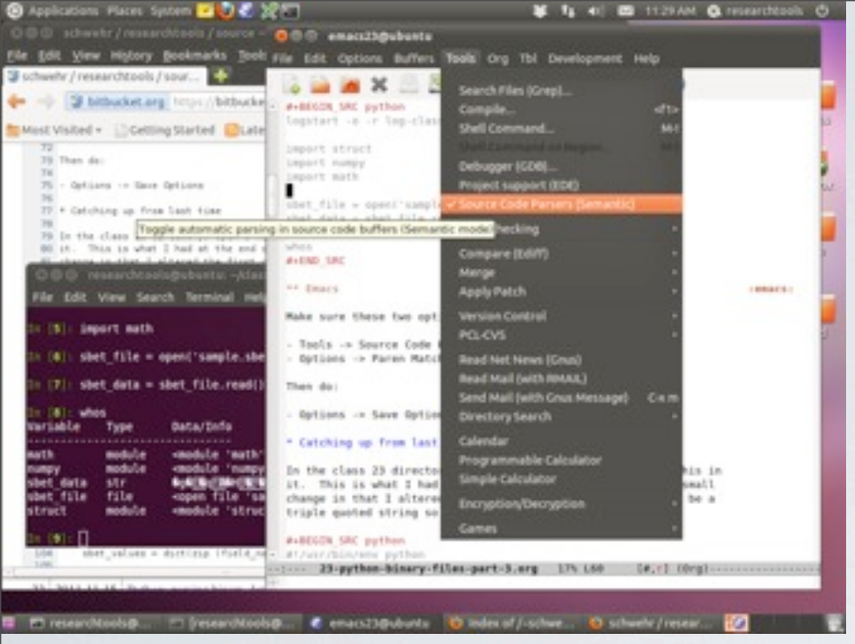

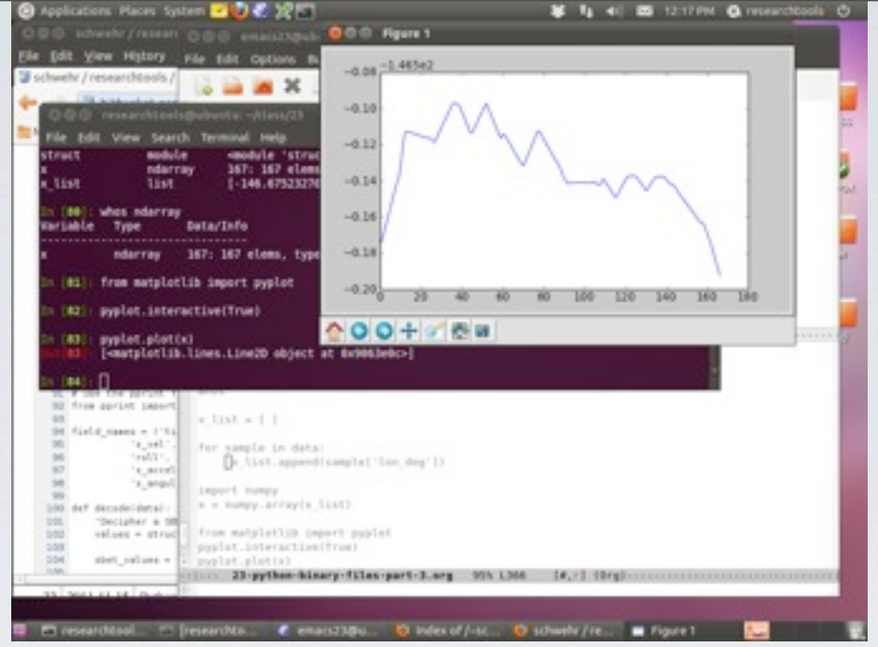

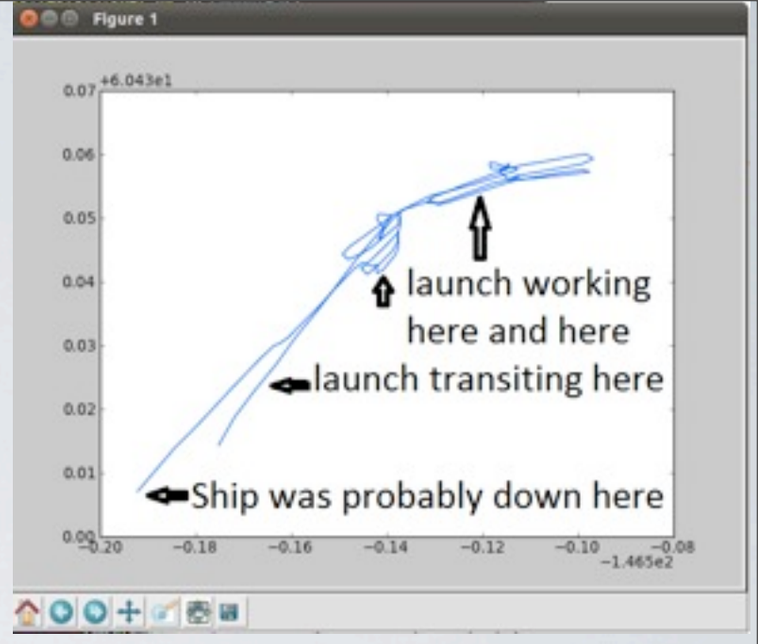

RESEARCH TOOLS 2011
LECTURE 23

2011-Nov-17
Kurt Schwehr
http://schwehr.org

UNH CCOM/JHC
Part 3 - Parsing binary in Python: SBET IMU navigation files

http://vislab-ccom.unh.edu/~schwehr/Classes/2011/esci895-researchtools/

Applications Places System 11:14 AM researchtools

researchtools@ubuntu

File Edit View Search Te

```
researchtools@ubuntu:~$ su
[sudo] password for resear
17 Nov 11:08:00 ntpdate[76
 sec
researchtools@ubuntu:~$
```

Index of /~schwehr/rt - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Index of /~schwehr/rt

vislab-ccom.unh.edu/~schwehr/rt/

Google

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removed the org links to encourage people to do exactly that. To get setup with the notes via hg:

```
mkdir ~/projects
cd ~/projects
sudo apt-get install mercurial # hg
hg clone https://bitbucket.org/schwehr/researchtools
```

You should update the notes before everytime you work on the material:

```
cd ~/projects/researchtools
hg pull
```

No.	Date	Title/Notes	Audio	Present	Video	Blog
28	2011-12-08	Last Class				
27	2011-12-06					
26	2011-12-01					
25	2011-11-29	Lecturer: Rob Braswell - R for Data Analysis				
	2011-11-24	No Class - Thanksgiving				
24	2011-11-22					
23	2011-11-17	Python: parsing binary data				

[11:09]
hyde matt_w
nhassan kjerram

esearchtools

[11:11]
mluke ahyde
nguyen nhassan

[11:12]
[11:13]
[11:14]

video

snippets

researchtools@ubunt... [researchtools@ubun... emacs23@ubuntu Index of /~schwehr/rt ...

Wednesday, November 23, 11

NOTE: There is a missing “hg update” after the “hg pull”!

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researchtools@ubuntu:~$ su
[sudo] password for resear
17 Nov 11:08:00 ntpdate[76
 sec
researchtools@ubuntu:~$

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Index of /~schwehr/rt | schwehr / researchtools / o...

bitbucket.org https://bitbucket.org/schwehr/researc

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schwehr is sharing code with you

Bitbucket is a code hosting site. Unlimited public and private repositories. Free for small teams.

Overview | Downloads (0) | Pull requests (0) | Source | Commits

branches » tags » RSS fork patch q

schwehr / researchtools http://vislab-ccom.unh.edu/~schwehr/Classes/2011/esci895-researchtools/

Course material for the UNH CCOM/JHC Research Tools course. This material was started during the Fall 2
semester. Covers emacs with org-mode, Bash command line, Python, Proj, GDAL/OGR, QGIS, and much m
tries to build a Linux and open source software base for students to build on. Please copy, remix and improv
material. License: Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License

Clone this repository (size: 231.3 KB): HTTPS / SSH

```
$ hg clone https://bitbucket.org/schwehr/researchtools
```

Recent commits See more »

video

snippets

researchtools@ubunt... [researchtools@ubun... emacs23@ubuntu schwehr / researchto...

Applications Places System 11:15 AM researchtools

researchtools@ubuntu:~$ su
[sudo] password for resear
17 Nov 11:08:00 ntpdate[76
 sec
researchtools@ubuntu:~$

schwehr / researchtools / overview — Bitbucket - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Index of /~schwehr/rt | schwehr / researchtools / o...

bitbucket.org https://bitbucket.org/schwehr/research

Google

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branches » tags » RSS fork patch que

schwehr / researchtools http://vislab-ccom.unh.edu/~schwehr/Classes/2011/esci895-researchtools/

Course material for the UNH CCOM/JHC Research Tools course. This material was started during the Fall 201 semester. Covers emacs with org-mode, Bash command line, Python, Proj, GDAL/OGR, QGIS, and much mo tries to build a Linux and open source software base for students to build on. Please copy, remix and improve t material. License: Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License

Clone this repository (size: 231.3 KB): **HTTPS** / SSH

```
$ hg clone https://bitbucket.org/schwehr/researchtools
```

Recent commits See more »

Author	Revision	Message
schwehr	1e468bdb2057	draft for class. goes up to plotting
schwehr	15862d1a90f7	initial version from what was unfinished from lecture 22
schwehr	f120c17ba765	adding raw dotfiles from my virtual machine. needs cleanup
schwehr	29822b85738c	removed material that will be in lecture 23. added histories
schwehr	a80f95cec229	re-organize into

video

snippets

https://bitbucket.org/s.../changeset/1e468bdb2057

researchtools@ubunt... [researchtools@ubun... emacs23@ubuntu schwehr / researchto...

Wednesday, November 23, 11

Applications Places System 11:15 AM researchtools

researchtools@ubuntu

File Edit View Search Te

```
researchtools@ubuntu:~$ su
[sudo] password for resear
17 Nov 11:08:00 ntpdate[76
 sec
researchtools@ubuntu:~$
```

schwehr / researchtools / changeset / 1e468bdb2057 — Bitbucket - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Index of /~schwehr/rt | schwehr / researchtools / c...

bitbucket.org https://bitbucket.org/schwehr/research

Google

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```
85      #!/usr/bin/env python
86
87      '''Decode Applanix POSPac SBET IMU binary files'''
88  96
89  97  import struct
    98  import numpy
90  99  import math
91      # Use the pprint function from the pprint module
92      from pprint import pprint
93 100
   101  sbet_file = open('sample.sbet')
   102  sbet_data = sbet_file.read()
94      field_names = ('time', 'latitude', 'longitude', 'altitude', \
95                'x_vel', 'y_vel', 'z_vel', \
96                'roll', 'pitch', 'platform_heading', 'wander_angle', \
97                'x_acceleration', 'y_acceleration', 'z_acceleration', \
98                'x_angular_rate', 'y_angular_rate', 'z_angular')
99 103
   104  whos
100     def decode(data):
101         'Decipher a SBET datagram from binary'
102         values = struct.unpack('17d',data[0:8*17])
103
104         sbet_values = dict(zip (field_names, values))
105
106         sbet_values['lat_deg'] = math.degrees(sbet_values['latitude'])
107         sbet_values['lon_deg'] = math.degrees(sbet_values['longitude'])
108
109         return sbet_values
110
111     def main():
112         print 'Starting main'
```

video

snippets

researchtools@ubunt... [researchtools@ubun... emacs23@ubuntu schwehr / researchto...

Wednesday, November 23, 11

Deletes are in red, additions in green. Note that this is a really bad color scheme. Many guys are red/green color blind.

Applications Places System 11:16 AM researchtools

Index of /~schwehr/rt - Mozilla F

File Edit View History Bookmarks To

Index of /~schwehr/rt

vislab-ccom.unh.edu/~schwe

Most Visited Getting Started La

```
mkdir ~/projects
cd ~/projects
sudo apt-get install mercurial #
hg clone https://bitbucket.org/s
```

You should update the notes before everytime

```
cd ~/projects/researchtools
hg pull
```

No.	Date	Title/N
28	2011-12-08	Last Class
27	2011-12-06	
26	2011-12-01	
25	2011-11-29	Lecturer: Rob Braswell - R for Data Analysis
	2011-11-24	No Class - Thanksgiving
24	2011-11-22	
23	2011-11-17	Python: parsing binary data - SBETs - Part 3
22	2011-11-15	Python: parsing binary data - SBETs - Part

researchtools@ubuntu: ~/projects/researchtools

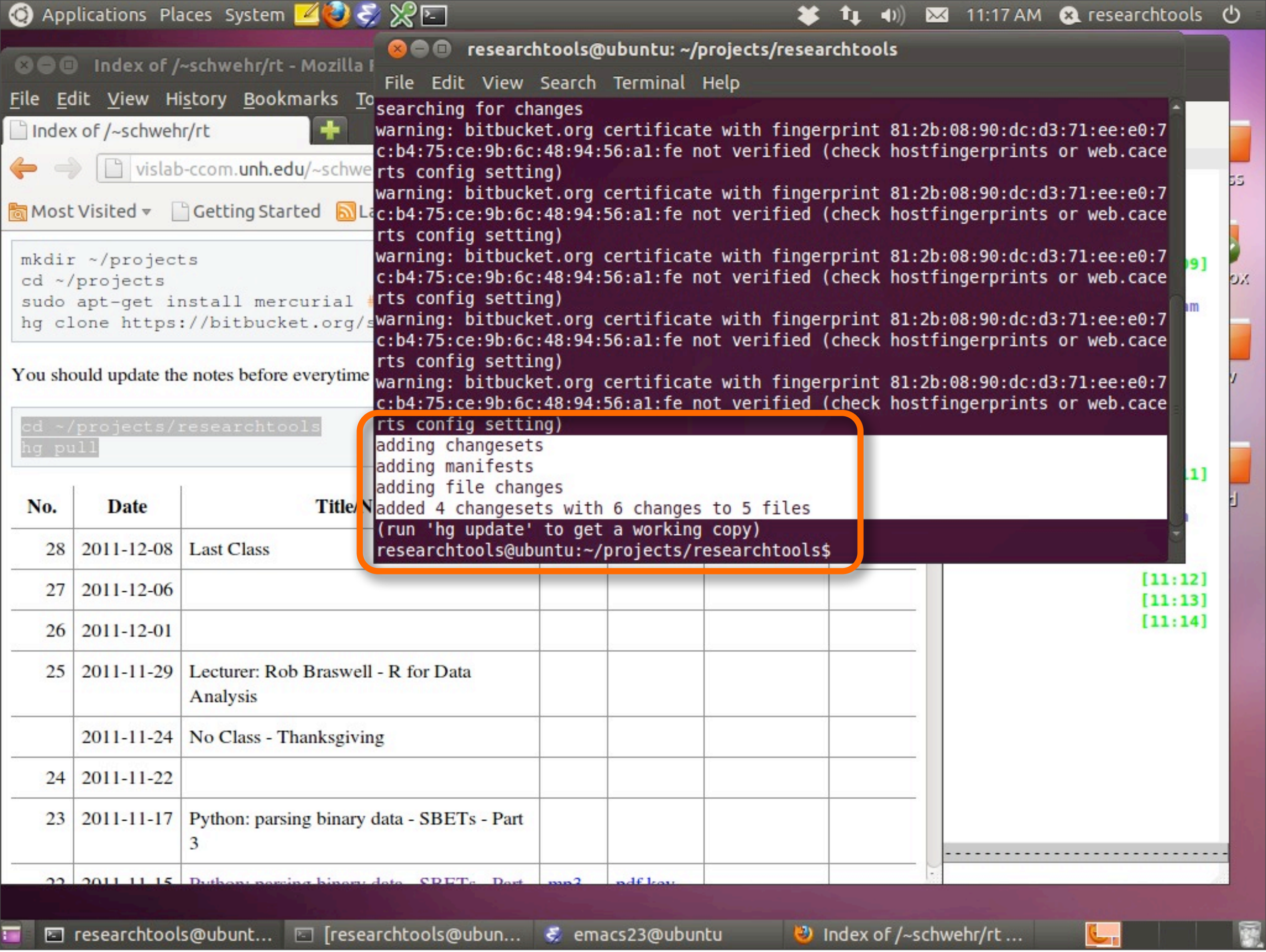
File Edit View Search Terminal Help

```
researchtools@ubuntu:~$ sudo ntpdate ntp.ubuntu.com
[sudo] password for researchtools:
17 Nov 11:08:00 ntpdate[7619]: step time server 91.189.94.4 offset 155989.447629
 sec
researchtools@ubuntu:~$  cd ~/projects/
researchtools@ubuntu:~/projects$ ls -l
total 4
drwxr-xr-x 6 researchtools researchtools 4096 2011-11-15 11:21 researchtools
researchtools@ubuntu:~/projects$ cd researchtools
researchtools@ubuntu:~/projects/researchtools$ hg pull
```

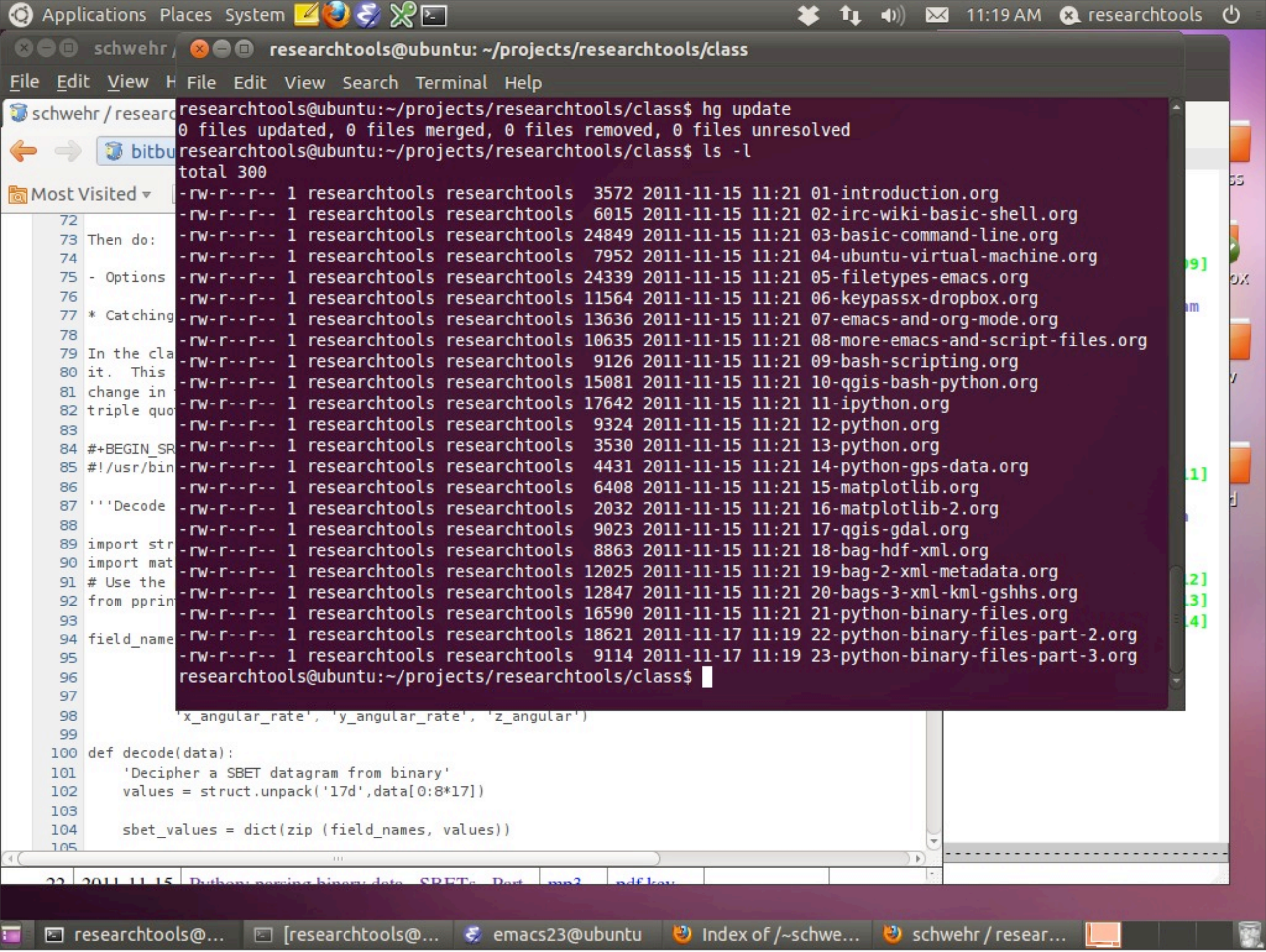
[11:12]
[11:13]
[11:14]

researchtools@ubunt... [researchtools@ubun... emacs23@ubuntu Index of /~schwehr/rt ...

First do a “hg pull” get the changes from the remote mercurial repository (“repo”) hosted on BitBucket.

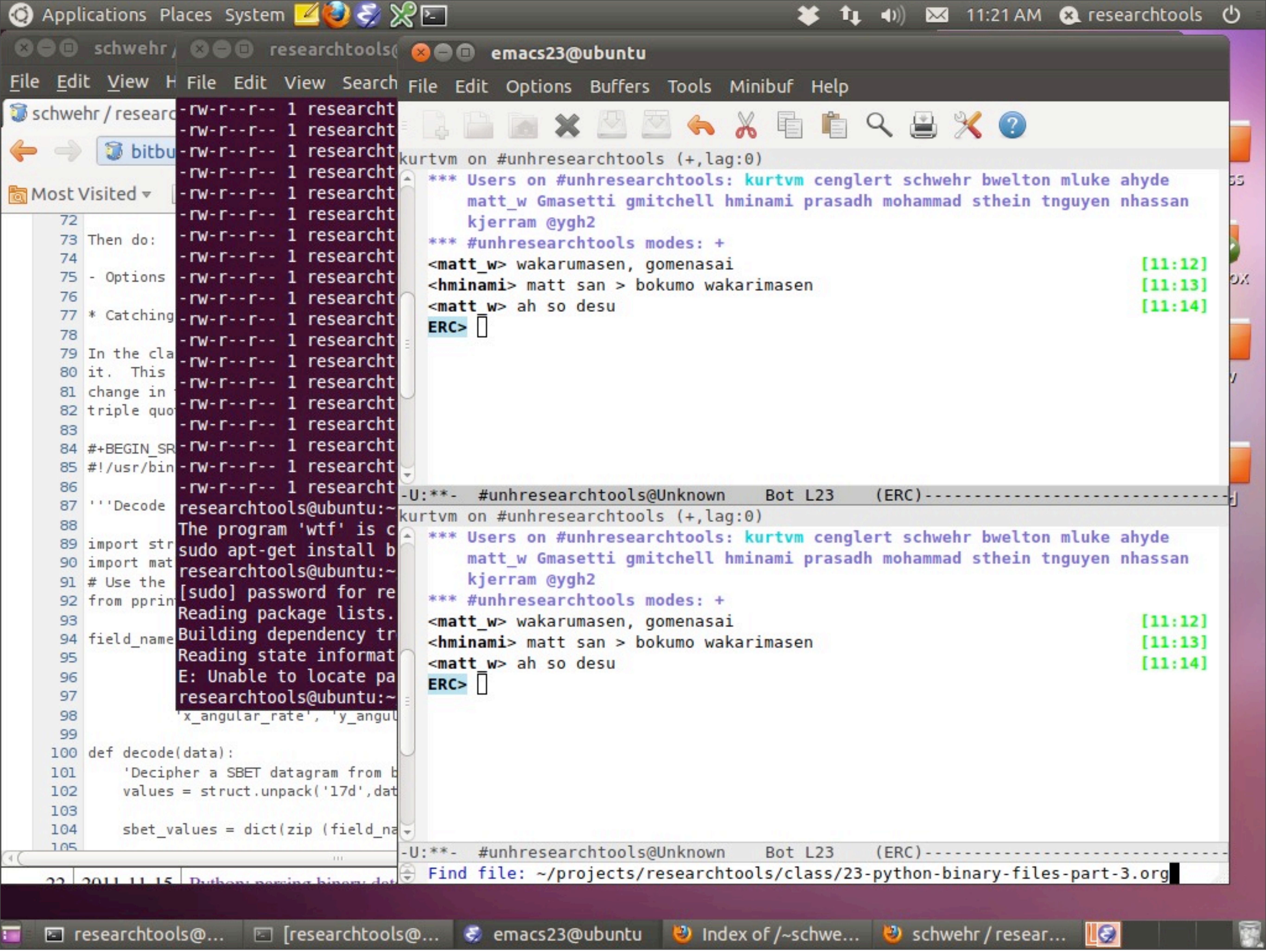


Here is the summary of changes that were “pulled” down to my virtual machine. Note that “hg pull” has told us that we next need to run “hg update” on the last line of our pull.



Wednesday, November 23, 11

I missed capturing the “hg update” that actually had the changes. The update here shows nothing changing, but we do have the class 23 org file!



Wednesday, November 23, 11

Open the org file from the mercurial repository in emacs.

Applications Places System 11:21 AM researchtools

schwehr / researc

File Edit View H

bitbu

Most Visited

```
72
73 Then do:
74
75 - Options
76
77 * Catching
78
79 In the cla
80 it.  This
81 change in
82 triple quo
83
84 #+BEGIN_SR
85 #!/usr/bin
86
87 '''Decode
88
89 import str
90 import mat
91 # Use the
92 from pprin
93
94 field_name
95
96
97
98             'x_angular_rate', 'y_angul
99
100 def decode(data):
101     'Decipher a SBET datagram from b
102     values = struct.unpack('17d',dat
103
104     sbet_values = dict(zip (field_na
105
```

researchtools

File Edit View Search

```
-rw-r--r-- 1 researcht
-rw-r--r-- 1 researcht
-rw-r--r-- 1 researcht
-rw-r--r-- 1 researcht
-rw-r--r-- 1 researcht
-rw-r--r-- 1 researcht
-rw-r--r-- 1 researcht
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-rw-r--r-- 1 researcht
-rw-r--r-- 1 researcht
-rw-r--r-- 1 researcht
-rw-r--r-- 1 researcht
-rw-r--r-- 1 researcht
researchtools@ubuntu:~
The program 'wtf' is c
sudo apt-get install b
researchtools@ubuntu:~
[sudo] password for re
Reading package lists.
Building dependency tr
Reading state informat
E: Unable to locate pa
researchtools@ubuntu:~
```

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Help

```
Open a terminal and get going:

#+BEGIN_SRC sh
# update your mercurial repository of the class notes
cd ~/projects/researchtools
hg pull
hg update

mkdir -p ~/class/23
cd ~/class/23

pwd
# Make sure you are in the right location
# ~/class/23
```

--:--- 23-python-binary-files-part-3.org 9% L31 Hg:9 (Org)----------

kurtvm on #unhresearchtools (+,lag:0)

```
*** Users on #unhresearchtools: kurtvm cenglert schwehr bwelton mluke ahyde
    matt_w Gmasetti gmitchell hminami prasadh mohammad sthein tnguyen nhassan
    kjerram @ygh2
*** #unhresearchtools modes: +
<matt_w> wakarumasen, gomenasai                                    [11:12]
<hminami> matt san > bokumo wakarimasen                            [11:13]
<matt_w> ah so desu                                                [11:14]
ERC>
```

-U:**- #unhresearchtools@Unknown Bot L23 (ERC)----------

Wrote /home/researchtools/projects/researchtools/class/23-python-binary-files-part-3.org

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Here I am updating the class notes to have the “hg update” that I missed.

Applications Places System 11:24 AM researchtools

schwehr / researchtools / source –

File Edit View History Bookmarks Tools

schwehr / researchtools / sour...

bitbucket.org https://bitbucke

Most Visited Getting Started Late

```
 72
 73 Then do:
 74
 75 - Options -> Save Options
 76
 77 * Catching up from last time
 78
 79 In the class 23 directory, open a ne
 80 it.  This is what I had at the end c
```

researchtools@ubuntu: ~/class

File Edit View Search Terminal Help

```
researchtools@ubuntu:~$ mkdir -p ~/c
researchtools@ubuntu:~$ cd ~/class/2
researchtools@ubuntu:~/class/23$ pwd
/home/researchtools/class/23
researchtools@ubuntu:~/class/23$ cp
 .
researchtools@ubuntu:~/class/23$
```

```
104     sbet_values = dict(zip (field_na
105
```

emacs23@ubuntu

File Edit Options Buffers Tools Minibuf Help

```
kurtvm on #unhresearchtools (+,lag:0)
*** Users on #unhresearchtools: kurtvm cenglert schwehr bwelton mluke ahyde
    matt_w Gmasetti gmitchell hminami prasadh mohammad sthein tnguyen nhassan
    kjerram @ygh2
*** #unhresearchtools modes: +
<matt_w> wakarumasen, gomenasai                                    [11:12]
<hminami> matt san > bokumo wakarimasen                            [11:13]
<matt_w> ah so desu                                                [11:14]
ERC>
```

-U:**- #unhresearchtools@Unknown Bot L23 (ERC)----------

Find file: ~/class/23/23-python-binary-files-part-3.org

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

After using “cp” to copy the file to the class working area, kill the buffer containing the org file in the hg repo and open the org file in the class working area: ~/class/23

Applications Places System 11:25 AM researchtools

schwehr / researchtools / source –

File Edit View History Bookmarks Tools

schwehr / researchtools / sour…

bitbucket.org https://bitbucke

Most Visited Getting Started Late

```
72
73 Then do:
74
75 - Options -> Save Options
76
77 * Catching up from last time
78
79 In the class 23 directory, open a ne
80 it.  This is what I had at the end c
```

researchtools@ubuntu: ~/class

File Edit View Search Terminal Help

```
researchtools@ubuntu:~$ mkdir -p ~/c
researchtools@ubuntu:~$ cd ~/class/2
researchtools@ubuntu:~/class/23$ pwd
/home/researchtools/class/23
researchtools@ubuntu:~/class/23$ cp
 .
researchtools@ubuntu:~/class/23$
```

```
104     sbet_values = dict(zip (field_na
105
```

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Help

Undo C-x u
Cut <cut>
Copy <copy>
Paste
Copy text in region to the clipboard
Paste from Kill Menu
Clear
Select All C-x h
Search
Replace
Go To
Bookmarks
Fill
Text Properties

```
#                                          ight location
#
#                                          ile from a web browser
#                                          n how get it from the researchtools
#                                            repository
cp                                         class/23-python-binary-files-part-3.org .

cu                                         nh.edu/~schwehr/Classes/2011/esci895-researchtools/e
bu

md
19                                         dc56  sample.sbet
#+

St                                         l

#+BEGIN_SRC python
logstart -o -r log-class-23.py

import struct
import numpy
import math

sbet_file = open('sample.sbet')
sbet_data = sbet_file.read()

whos
#+END_SRC

** Emacs                                                    :emacs:

Make sure these two options are checked in your emacs:
```

--:--- **23-python-binary-files-part-3.org** 11% L47 [#,r] (Org)----------

researchtools@… [researchtools@… emacs23@ubuntu Index of /~schwe… schwehr / resear…

Wednesday, November 23, 11

Applications Places System 11:27 AM researchtools

schwehr / researchtools / source –

File Edit View History Bookmarks Tools

schwehr / researchtools / sour...

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Most Visited Getting Started Late

```
 72
 73 Then do:
 74
 75 - Options -> Save Options
 76
 77 * Catching up from last time
 78
 79 In the class 23 directory, open a ne
 80 it.  This is what I had at the end c
 81 change in that I altered the first c
```

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Help

```
# Make sure you are in the right location
# ~/class/23

# Rather than downloading the org file from a web browser
# or using wget/curl, you can now get it from the researchtools
# mercurial revision control repository
cp ~/projects/researchtools/class/23-python-binary-files-part-3.org .

curl -O http://vislab-ccom.unh.edu/~schwehr/Classes/2011/esci895-researchtools/e
bunzip2 sample.sbet.bz2

md5sum sample.sbet
```

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
researchtools@ubuntu:~$ mkdir -p ~/class/23
researchtools@ubuntu:~$ cd ~/class/23
researchtools@ubuntu:~/class/23$ pwd
/home/researchtools/class/23
researchtools@ubuntu:~/class/23$ cp ~/projects/researchtools/class/23-python-binary-files-part-3.org
 .
researchtools@ubuntu:~/class/23$ curl -O http://vislab-ccom.unh.edu/~schwehr/Classes/2011/esci895-re
searchtools/examples/21/sample.sbet.bz2
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100 22473  100 22473    0     0   943k      0 --:--:-- --:--:-- --:--:-- 2438k
researchtools@ubuntu:~/class/23$ bunzip2 sample.sbet.bz2
researchtools@ubuntu:~/class/23$ md5sum sample.sbet
196c21f16f07ceae180888b12e9edc56  sample.sbet
researchtools@ubuntu:~/class/23$
```

```
104     sbet_values = dict(zip (field_na
105
```

Make sure these two options are checked in your emacs:

```
--:---  23-python-binary-files-part-3.org   11% L42     [#,r] (Org)----------
```

:emacs:

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 11:27 AM researchtools

schwehr / researchtools / source –

File Edit View History Bookmarks Tools

schwehr / researchtools / sour...

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Most Visited Getting Started Late

```
 72
 73 Then do:
 74
 75 - Options -> Save Options
 76
 77 * Catching up from last time
 78
 79 In the class 23 directory, open a ne
 80 it.  This is what I had at the end c
```

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Help

```
#+BEGIN_SRC python
logstart -o -r log-class-23.py

import struct
import numpy
import math

sbet_file = open('sample.sbet')
sbet_data = sbet_file.read()

whos
#+END_SRC
```

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
IPython 0.10.1 -- An enhanced Interactive Python.
?         -> Introduction and overview of IPython's features.
%quickref -> Quick reference.
help      -> Python's own help system.
object?   -> Details about 'object'. ?object also works, ?? prints more.

In [1]: logstart -o -r log-class-23.py
Activating auto-logging. Current session state plus future input saved.
Filename       : log-class-23.py
Mode           : backup
Output logging : True
Raw input log  : True
Timestamping   : False
State          : active

In [2]: ls
```

```
104     sbet_values = dict(zip (field_na
105
```

#!/usr/bin/env python

--:--- 23-python-binary-files-part-3.org 17% L70 [#,r] (Org)----------

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 11:28 AM researchtools

schwehr / researchtools / source –

File Edit View History Bookmarks Tools

schwehr / researchtools / sour...

bitbucket.org https://bitbucke

Most Visited Getting Started Late

```
 72
 73 Then do:
 74
 75 - Options -> Save Options
 76
 77 * Catching up from last time
 78
 79 In the class 23 directory, open a ne
 80 it.  This is what I had at the end o
```

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Help

```
#+BEGIN_SRC python
logstart -o -r log-class-23.py

import struct
import numpy
import math

sbet_file = open('sample.sbet')
sbet_data = sbet_file.read()

whos
#+END_SRC
```

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
Timestamping   : False
State          : active

In [2]: ls
23-python-binary-files-part-3.org  log-class-23.py  sample.sbet

In [3]: import struct

In [4]: import numpy

In [5]: import math

In [6]: sbet_file = open('sample.sbet')

In [7]: sbet_data = sbet_file.read()

In [8]:
```

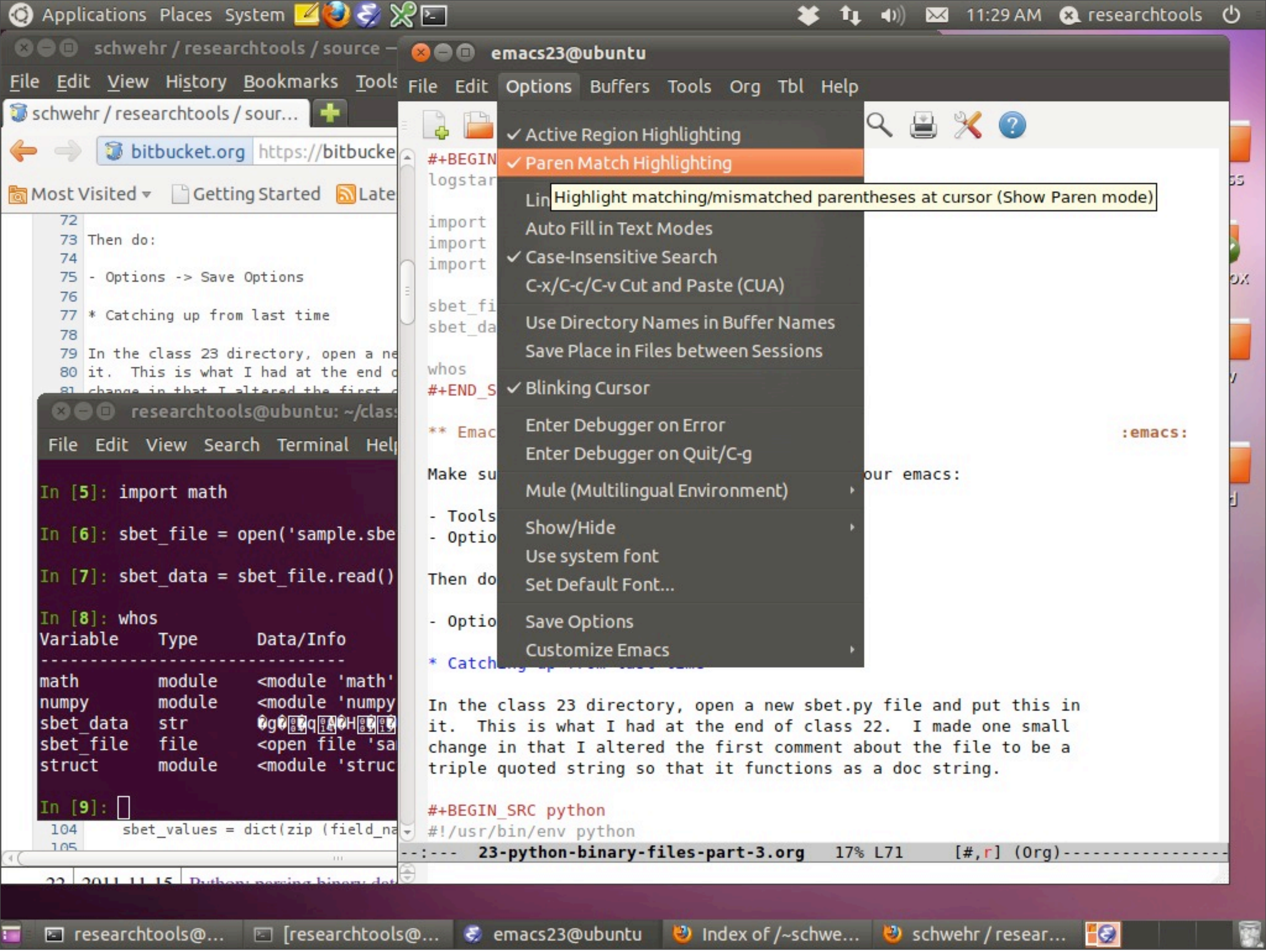
```
104     sbet_values = dict(zip (field_na
105
```

#!/usr/bin/env python

--:--- 23-python-binary-files-part-3.org 17% L70 [#,r] (Org)----------

:emacs:

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...



emacs23@ubuntu
File Edit Options Buffers Tools Org Tbl Help
✓ Active Region Highlighting
✓ Paren Match Highlighting
Highlight matching/mismatched parentheses at cursor (Show Paren mode)
Auto Fill in Text Modes
✓ Case-Insensitive Search
C-x/C-c/C-v Cut and Paste (CUA)
Use Directory Names in Buffer Names
Save Place in Files between Sessions
✓ Blinking Cursor
Enter Debugger on Error
Enter Debugger on Quit/C-g
Mule (Multilingual Environment)
Show/Hide
Use system font
Set Default Font...
Save Options
Customize Emacs
In the class 23 directory, open a new sbet.py file and put this in
it. This is what I had at the end of class 22. I made one small
change in that I altered the first comment about the file to be a
triple quoted string so that it functions as a doc string.
#+BEGIN_SRC python
#!/usr/bin/env python
23-python-binary-files-part-3.org 17% L71 (Org)
In [5]: import math
In [6]: sbet_file = open('sample.sbe
In [7]: sbet_data = sbet_file.read()
In [8]: whos
Variable Type Data/Info
math module <module 'math'
numpy module <module 'numpy
sbet_data str
sbet_file file <open file 'sa
struct module <module 'struc
In [9]:

Applications Places System 11:29 AM researchtools

schwehr / researchtools / source –

File Edit View History Bookmarks Tools

schwehr / researchtools / sour…

bitbucket.org https://bitbucke

Most Visited Getting Started Late

```
72
73 Then do:
74
75 - Options -> Save Options
76
77 * Catching up from last time
78
79 In the class
80 it.  This is what I had at the end
81 change in that I altered the first
```

researchtools@ubuntu: ~/class

File Edit View Search Terminal Help

```
In [5]: import math

In [6]: sbet_file = open('sample.sbe

In [7]: sbet_data = sbet_file.read()

In [8]: whos
Variable    Type       Data/Info
-----------------------------
math        module     <module 'math'
numpy       module     <module 'numpy
sbet_data   str        ?g??q??H??
sbet_file   file       <open file 'sa
struct      module     <module 'struc

In [9]:
```

```
104     sbet_values = dict(zip (field_na
105
```

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Development Help

```
#+BEGIN_SRC python
logstart -o -r log-class

import struct
import numpy
import math

sbet_file = open('sample
sbet_data = sbet_file.r
whos
#+END_SRC

** Emacs

Make sure these two opti

- Tools -> Source Code
- Options -> Paren Match

Then do:

- Options -> Save Optio

* Catching up from last

In the class 23 directo                    his in
it.  This is what I had                    small
change in that I altere                    be a
triple quoted string so

#+BEGIN_SRC python
#!/usr/bin/env python
```

Search Files (Grep)...
Compile... <f1>
Shell Command... M-!
Shell Command on Region... M-|
Debugger (GDB)...
Project support (EDE)
✓ Source Code Parsers (Semantic)
hecking
Compare (Ediff)
Merge
Apply Patch
Version Control
PCL-CVS
Read Net News (Gnus)
Read Mail (with RMAIL)
Send Mail (with Gnus Message) C-x m
Directory Search
Calendar
Programmable Calculator
Simple Calculator
Encryption/Decryption
Games

Toggle automatic parsing in source code buffers (Semantic mode)

:emacs:

--:--- 23-python-binary-files-part-3.org 17% L60 [#,r] (Org)----------

researchtools@… [researchtools@… emacs23@ubuntu Index of /~schwe… schwehr / resear…

Wednesday, November 23, 11

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File Edit View History Bookmarks Tools

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Most Visited Getting Started Late

```
 72
 73 Then do:
 74
 75 - Options -> Save Options
 76
 77 * Catching up from last time
 78
 79 In the class 23 directory, open a ne
 80 it.  This is what I had at the end o
 81 change in that I altered the first c
```

researchtools@ubuntu: ~/class

File Edit View Search Terminal Help

```
In [5]: import math

In [6]: sbet_file = open('sample.sbe

In [7]: sbet_data = sbet_file.read()

In [8]: whos
Variable    Type      Data/Info
-----------------------------
math        module    <module 'math'
numpy       module    <module 'numpy
sbet_data   str       ?g??q??H??
sbet_file   file      <open file 'sa
struct      module    <module 'struc

In [9]:
```

```
104     sbet_values = dict(zip (field_na
105
```

22 2011-11-15 Python: parsing binary dat

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Development Help

```
#+BEGIN
logstar

import
import
import
sbet_fi
sbet_da

whos
#+END_S

** Emac

Make su

- Tools
- Optio

Then do

- Optio

* Catching up

In the class 23 directory, open a new sbet.py file and put this in
it.  This is what I had at the end of class 22.  I made one small
change in that I altered the first comment about the file to be a
triple quoted string so that it functions as a doc string.

#+BEGIN_SRC python
#!/usr/bin/env python
```

:emacs:

our emacs:

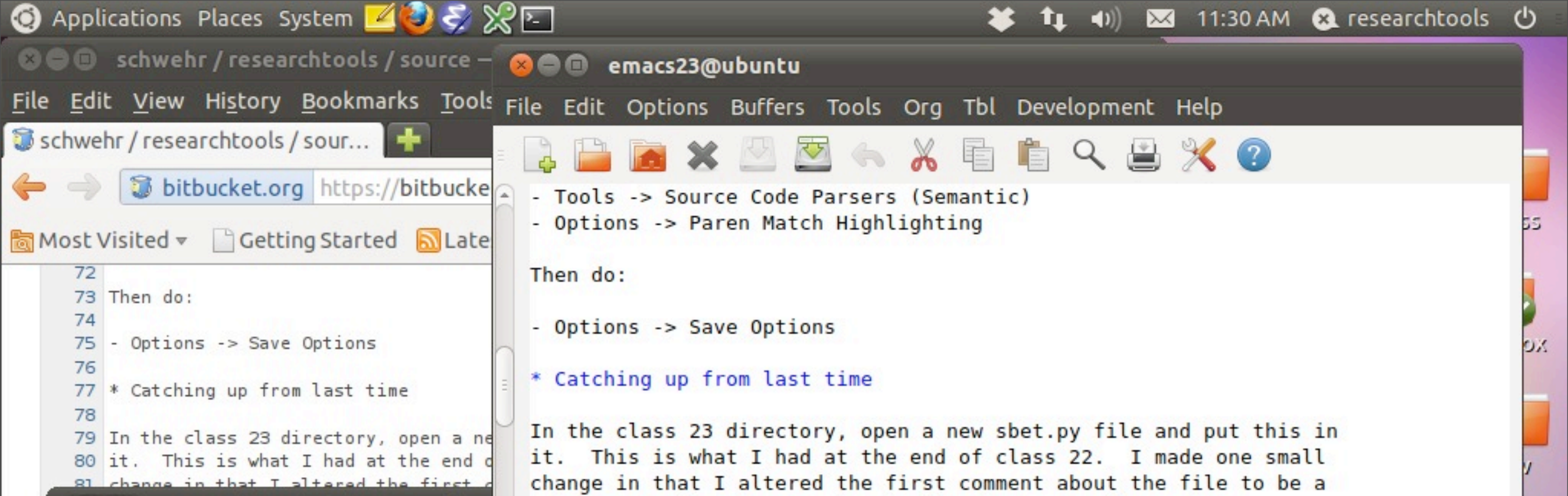
- ✓ Active Region Highlighting
- ✓ Paren Match Highlighting
- Line Wrapping in this Buffer
- Auto Fill in Text Modes
- ✓ Case-Insensitive Search
- C-x/C-c/C-v Cut and Paste (CUA)
- Use Directory Names in Buffer Names
- Save Place in Files between Sessions
- ✓ Blinking Cursor
- Enter Debugger on Error
- Enter Debugger on Quit/C-g
- Mule (Multilingual Environment)
- Show/Hide
- Use system font
- Set Default Font...
- Save Options
- Customize Emacs

Save options set from the menu above

--:--- 23-python-binary-files-part-3.org 17% L60 [#,r] (Org)----------

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11



Wednesday, November 23, 11

Create a new sbet.py python file in ~/class/23. To catch up from last class (22), copy everything from this python source block in the class notes into this new sbet.py file.

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Most Visited Getting Started Late

```
72
73 Then do:
74
75 - Options -> Save Options
76
77 * Catching up from last time
78
79 In the class 23 directory, open a ne
80 it.  This is what I had at the end o
```

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File Edit View Search Terminal Help

```
In [5]: import math

In [6]: sbet_file = open('sample.sbe

In [7]: sbet_data = sbet_file.read()

In [8]: whos
Variable    Type       Data/Info
-----------------------------
math        module     <module 'math'
numpy       module     <module 'numpy
sbet_data   str        [illegible]
sbet_file   file       <open file 'sa
struct      module     <module 'struc

In [9]:
```

```
104     sbet_values = dict(zip (field_na
105
```

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File Edit Options Buffers Tools Org Tbl Development Help

```
    sbet_values = dict(zip (field_names, values))

    sbet_values['lat_deg'] = math.degrees(sbet_values['latitude'])
    sbet_values['lon_deg'] = math.degrees(sbet_values['longitude'])

    return sbet_values

def main():
    print 'Starting main'
    sbet_file = open('sample.sbet')
    sbet_data = sbet_file.read()

    print 'Read this many bytes:', len(sbet_data)

    datagram = decode(sbet_data)
    # Use the pprint function from the pprint module
    pprint(datagram)

    print 'Finish main'

if __name__ == '__main__':
    print 'starting to run script...'
    main()
    print 'script done!'
#+END_SRC

* Being able to use the whole SBET file

There are many datagrams / messages and they are spaced every 136
bytes ( 8 byte double precision floating point numbers and we have 17
of them, so 8*17 bytes).  We now need to add a 2nd parameter to our
decode function - an =offset= into the =data= variable.   Make the
default of =offset= to be the start of the data or the number "0".
```

--:--- **23-python-binary-files-part-3.org** 31% L129 [#,r] (Org)----------

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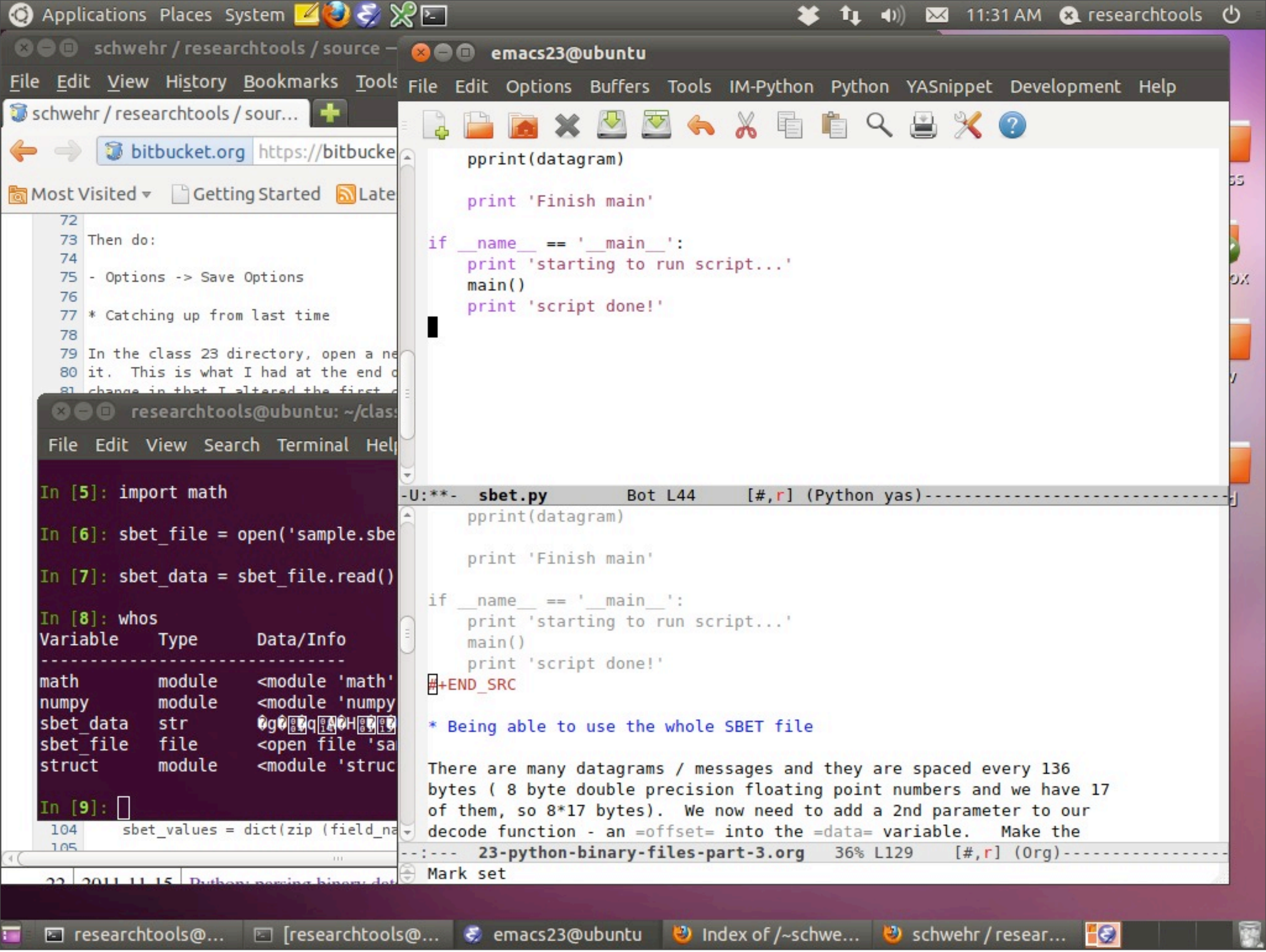
Wednesday, November 23, 11



Wednesday, November 23, 11

I've now pasted the code into sbet.py. Note the two "**" in the emacs status to the left of the "sbet.py Bot L44". That means I still need to save the file with C-x C-s.

Applications Places System 11:31 AM researchtools

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Most Visited Getting Started Late

```
 72
 73 Then do:
 74
 75 - Options -> Save Options
 76
 77 * Catching up from last time
 78
 79 In the class 23 directory, open a ne
 80 it.  This is what I had at the end c
 81 change in that I altered the first
```

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File Edit Options Buffers Tools Org Tbl Development Help

```
    pprint(datagram)

    print 'Finish main'

if __name__ == '__main__':
    print 'starting to run script...'
    main()
    print 'script done!'
```

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
struct      module    <module 'struct' from '/u<...>ib/python2.7/struct.pyc'>

In [9]: run sbet
starting to run script...
Starting main
Read this many bytes: 22712
{'altitude': 12.826300557342815,
 'lat_deg': 60.444312306421736,
 'latitude': 1.0549522638507869,
 'lon_deg': -146.6752327043359,
 'longitude': -2.559965741819528,
 'pitch': 0.11416603057936824,
 'platform_heading': -0.09985686530029529,
 'roll': -0.0026283394812042344,
 'time': 334959.0048233234,
 'wander_angle': -0.40154673926674145,
 'x_acceleration': -0.8249097558096672,
```

```
104     sbet_values = dict(zip (field_na
105
```

decode function - an =offset= into the =data= variable. Make the

--:--- 23-python-binary-files-part-3.org 36% L133 [#,r] (Org)----------

136
have 17
our

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 11:33 AM researchtools

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72
73 Then do:
74
75 - Options -> Save Options
76
77 * Catching up from last time
78
79 In the class 23 directory, open a ne
80 it.  This is what I had at the end c
```

researchtools@ubuntu: ~/class

File Edit View Search Terminal Help

```
struct      module    <module 'struc

In [9]: run sbet
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{'altitude': 12.826300557342815,
 'lat_deg': 60.444312306421736,
 'latitude': 1.0549522638507869,
 'lon_deg': -146.6752327043359,
 'longitude': -2.559965741819528,
 'pitch': 0.11416603057936824,
 'platform_heading': -0.099856865300
 'roll': -0.0026283394812042344,
 'time': 334959.0048233234,
 'wander_angle': -0.4015467392667414
 'x_acceleration': -0.82490975580966
```

```
104     sbet_values = dict(zip (field_na
105
```

emacs23@ubuntu

File Edit Options Buffers Tools IM-Python Python YASnippet Development Help

```
    pprint(datagram)

    print 'Finish main'

if __name__ == '__main__':
    print 'starting to run script...'
    main()
    print 'script done!'
```

-U:--- sbet.py Bot L44 [#,r] (Python yas)----------

```
#+END_SRC

* Being able to use the whole SBET file

There are many datagrams / messages and they are spaced every 136
bytes ( 8 byte double precision floating point numbers and we have 17
of them, so 8*17 bytes).  We now need to add a 2nd parameter to our
decode function - an =offset= into the =data= variable.   Make the
default of =offset= to be the start of the data or the number "0".

#+BEGIN_SRC python
def decode(data, offset=0):
#+END_SRC

Now change the =struct.unpack= line to pass in a section of data that
depends on the offset:
```

--:--- 23-python-binary-files-part-3.org 38% L140 [#,r] (Org)----------

menu-bar index

Rescan
Variables
Functions → decode() | main()
Imports
Code

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

First run “*Rescan*” under the IM-Python menu. Then jump to the decode function.

Applications Places System 11:35 AM researchtools

schwehr / researchtools / source

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schwehr / researchtools / sour...

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Most Visited Getting Started Late

```
72
73 Then do:
74
75 - Options -> Save Options
76
77 * Catching up from last time
78
79 In the class 23 directory, open a ne
80 it.  This is what I had at the end o
81 change in that I altered the first
```

researchtools@ubuntu: ~/class

File Edit View Search Terminal Help

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struct      module    <module 'struc

In [9]: run sbet
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 'lat_deg': 60.444312306421736,
 'latitude': 1.0549522638507869,
 'lon_deg': -146.6752327043359,
 'longitude': -2.559965741819528,
 'pitch': 0.11416603057936824,
 'platform_heading': -0.099856865300
 'roll': -0.0026283394812042344,
 'time': 334959.0048233234,
 'wander_angle': -0.4015467392667414
 'x_acceleration': -0.82490975580966
```

```
104     sbet_values = dict(zip (field_na
105
```

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File Edit Options Buffers Tools IM-Python Python YASnippet Development Help

```
from pprint import pprint

field_names = ('time', 'latitude', 'longitude', 'altitude', \
               'x_vel', 'y_vel', 'z_vel', \
               'roll', 'pitch', 'platform_heading', 'wander_angle', \
               'x_acceleration', 'y_acceleration', 'z_acceleration', \
               'x_angular_rate', 'y_angular_rate', 'z_angular')

def decode(data, offset=0):
    'Decipher a SBET datagram from binary'
    values = struct.unpack('17d',data[ offset + 0 : offset + 8*17])

    sbet_values = dict(zip (field_names, values))

    sbet_values['lat_deg'] = math.degrees(sbet_values['latitude'])
    sbet_values['lon_deg'] = math.degrees(sbet_values['longitude'])
```

-U:**- sbet.py 13% L18 [#,r] (Python yas)----------

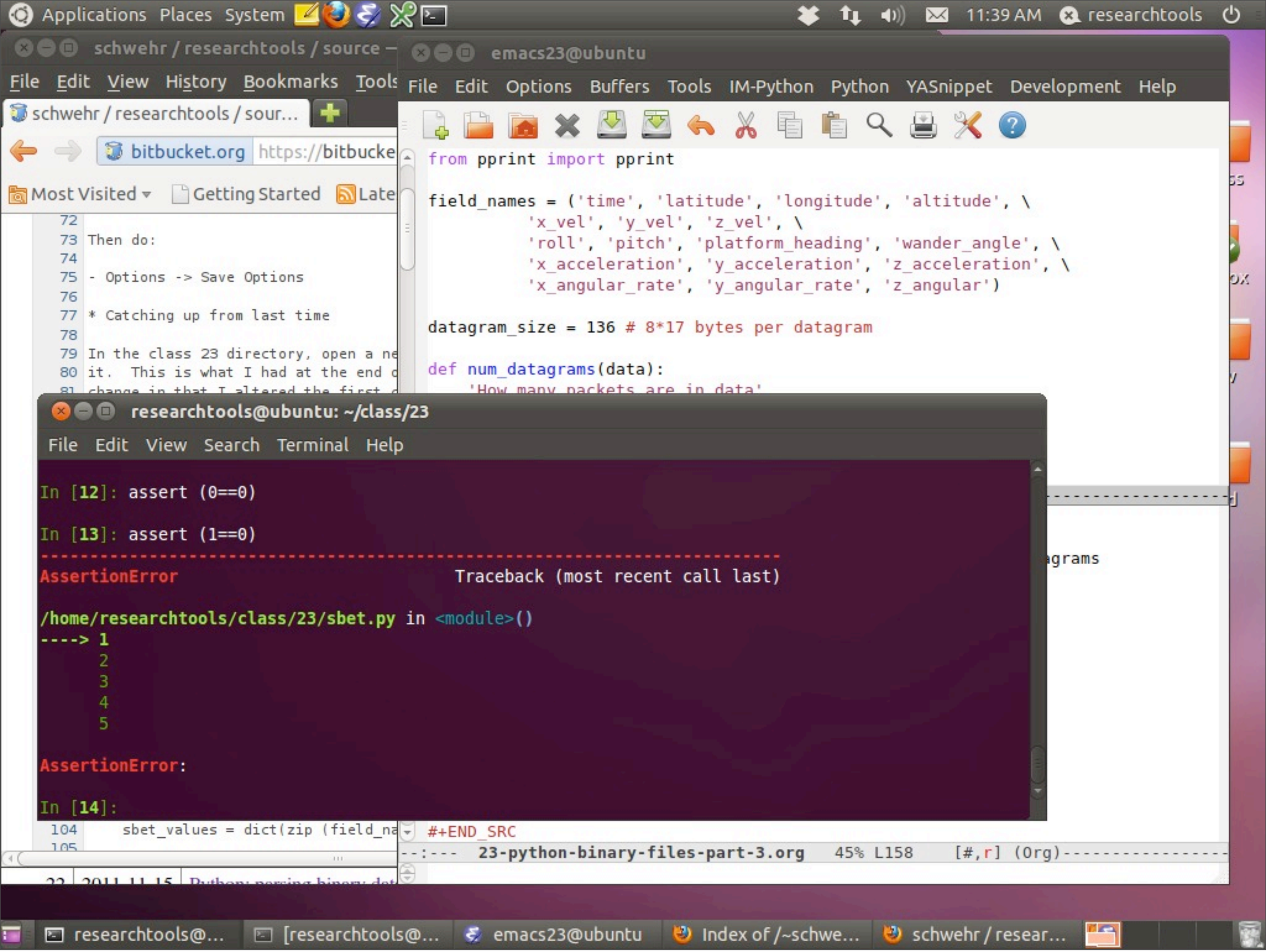
```
#+END_SRC

* Being able to use the whole SBET file

There are many datagrams / messages and they are spaced every 136
bytes ( 8 byte double precision floating point numbers and we have 17
of them, so 8*17 bytes).  We now need to add a 2nd parameter to our
decode function - an =offset= into the =data= variable.   Make the
default of =offset= to be the start of the data or the number "0".

#+BEGIN_SRC python
def decode(data, offset=0):
#+END_SRC

Now change the =struct.unpack= line to pass in a section of data that
depends on the offset:
```

--:--- 23-python-binary-files-part-3.org 38% L140 [#,r] (Org)----------

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

I've highlight the two areas that we need to change in the decode function



Wednesday, November 23, 11

http://wiki.python.org/moin/UsingAssertionsEffectively

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Most Visited Getting Started Late

```
72
73 Then do:
74
75 - Options -> Save Options
76
77 * Catching up from last time
78
79 In the class 23 directory, open a ne
80 it.  This is what I had at the end o
```

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File Edit Options Buffers Tools IM-Python Python YASnippet Development Help

```
from pprint import pprint

field_names = ('time', 'latitude', 'longitude', 'altitude', \
               'x_vel', 'y_vel', 'z_vel', \
               'roll', 'pitch', 'platform_heading', 'wander_angle', \
               'x_acceleration', 'y_acceleration', 'z_acceleration', \
               'x_angular_rate', 'y_angular_rate', 'z_angular')

datagram_size = 136 # 8*17 bytes per datagram

def num_datagrams(data):
    'How many packets are in data'
```

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

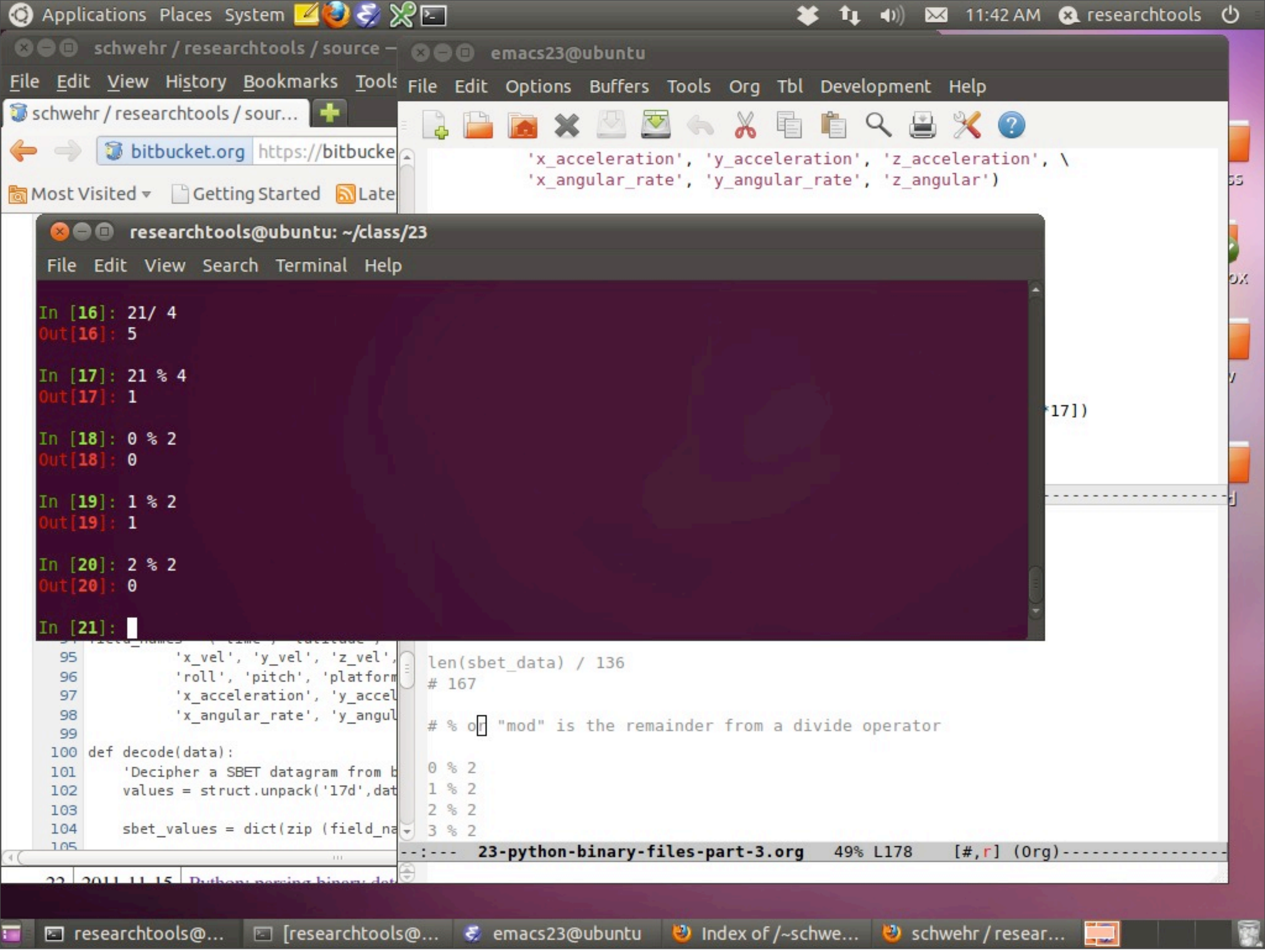
```
In [14]: assert(True)

In [15]: assert(False)
---------------------------------------------------------------------------
AssertionError                            Traceback (most recent call last)

/home/researchtools/class/23/sbet.py in <module>()
----> 1
      2
      3
      4
      5

AssertionError:

In [16]:
```

```
104     sbet_values = dict(zip (field_na
105
```

```
#+END_SRC
--:---  23-python-binary-files-part-3.org   45% L158    [#,r] (Org)----------
Using the CPython shell
```

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11



Wednesday, November 23, 11

% means “mod”, which means the remainder when doing integer division.

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```
In [19]: 1 % 2
Out[19]: 1

In [20]: 2 % 2
Out[20]: 0

In [21]: 3 % 2
Out[21]: 1

In [22]: 100 % 5
Out[22]: 0

In [23]: 104 % 5
Out[23]: 4

In [24]:
```

```
 95            'x_vel', 'y_vel', 'z_vel',
 96            'roll', 'pitch', 'platform
 97            'x_acceleration', 'y_accel
 98            'x_angular_rate', 'y_angul
 99
100 def decode(data):
101     'Decipher a SBET datagram from b
102     values = struct.unpack('17d',dat
103
104     sbet_values = dict(zip (field_na
105
```

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```
          'x_acceleration', 'y_acceleration', 'z_acceleration', \
          'x_angular_rate', 'y_angular_rate', 'z_angular')

datagram_size = 136 # 8*17 bytes per datagram

def num_datagrams(data):
    'How many packets are in data'

    assert( len(data) % datagram_size == 0 )

    return len(data) / datagram_size

def decode(data, offset=0):
    'Decipher a SBET datagram from binary'
    values = struct.unpack('17d',data[ offset + 0 : offset + 8*17])
```

-U:--- sbet.py 25% L23 [#,r] (Python yas)

```
def num_datagrams(data):
    'How many packets are in data'

    # Make sure we have an even number of datagrams
    assert (len(data) % datagram_size == 0)

    return len(data) / datagram_size
#+END_SRC

Try it out from ipython:

#+BEGIN_SRC python
reload sbet

len(sbet_data)
# 22712
```

--:--- 23-python-binary-files-part-3.org 47% L171 [#,r] (Org)

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Wednesday, November 23, 11

Applications Places System 11:45 AM researchtools

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File Edit View History Bookmarks Tools

schwehr / researchtools / sour...

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File Edit Options Buffers Tools Org Tbl Development Help

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
In [24]: import sbet

In [25]: reload sbet
-------> reload(sbet)
Out[25]: <module 'sbet' from 'sbet.pyc'>

In [26]: len(sbet_data)
Out[26]: 22712

In [27]: len(sbet_data) / 136
Out[27]: 167

In [28]: 22712 % 136
Out[28]: 0

In [29]: sbet.num_datagrams( sbet_data )
```

```
# Use the pprint function from the p
from pprint import pprint

field_names = ('time', 'latitude', '
          'x_vel', 'y_vel', 'z_vel',
          'roll', 'pitch', 'platform
          'x_acceleration', 'y_accel
          'x_angular_rate', 'y_angul

def decode(data):
    'Decipher a SBET datagram from b
    values = struct.unpack('17d',dat

    sbet_values = dict(zip (field_na
```

```
104 % 3

len(sbet_data) % 136
# 0

sbet.num_datagrams( sbet_data )
# 167
#+END_SRC

So now we know that there are 167 messages in our SBET file!

Our second helper that we need is the ability to get the offset for a
datagram/message number:
```

--:--- 23-python-binary-files-part-3.org 51% L192 [#,r] (Org)

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Wednesday, November 23, 11

Applications Places System 11:49 AM researchtools

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File Edit View History Bookmarks Tools

schwehr / researchtools / sour…

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File Edit View Search Terminal Hel

```
In [26]: len(sbet_data)
Out[26]: 22712

In [27]: len(sbet_data) / 136
Out[27]: 167

In [28]: 22712 % 136
Out[28]: 0

In [29]: sbet.num_datagrams( sbet_da
Out[29]: 167

In [30]: 50 * 136
Out[30]: 6800

In [31]:
```

```
 91 # Use the pprint function from the p
 92 from pprint import pprint
 93
 94 field_names = ('time', 'latitude', '
 95           'x_vel', 'y_vel', 'z_vel',
 96           'roll', 'pitch', 'platform
 97           'x_acceleration', 'y_accel
 98           'x_angular_rate', 'y_angul
 99
100 def decode(data):
101     'Decipher a SBET datagram from b
102     values = struct.unpack('17d',dat
103
104     sbet_values = dict(zip (field_na
105
```

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File Edit Options Buffers Tools IM-Python Python YASnippet Development Help

```
          'x_acceleration', 'y_acceleration', 'z_acceleration', \
          'x_angular_rate', 'y_angular_rate', 'z_angular')

datagram_size = 136 # 8*17 bytes per datagram

def num_datagrams(data):
    'How many packets are in data'

    assert( len(data) % datagram_size == 0 )

    return len(data) / datagram_size

def get_offset(datagram_number):
    'Calculate the starting offset of a datagram.  First datagram is number 0'
    return datagram_number * datagram_size
```

-U:--- **sbet.py** 22% L27 [#,r] (Python yas)----------

```
sbet.num_datagrams( sbet_data )
# 167
#+END_SRC

So now we know that there are 167 messages in our SBET file!

Our second helper that we need is the ability to get the offset for a
datagram/message number:

#+BEGIN_SRC python
def get_offset(datagram_number):
    'Calculate the starting offset of a datagram.  First is dg num 0'
    return datagram_number * datagram_size
#+END_SRC

Try it!
```

--:--- **23-python-binary-files-part-3.org** 52% L202 [#,r] (Org)----------

Wrote /home/researchtools/class/23/sbet.py

researchtools@… [researchtools@… emacs23@ubuntu Index of /~schwe… schwehr / resear…

Wednesday, November 23, 11

Applications Places System 11:52 AM researchtools

schwehr / researchtools / source –

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File Edit View Search Terminal Hel

```
In [31]: reload sbet
-------> reload(sbet)
Out[31]: <module 'sbet' from 'sbet.p

In [32]: sbet.get_offset(0)
Out[32]: 0

In [33]: sbet.get_offset(1)
Out[33]: 136

In [34]: sbet.get_offset(125)
Out[34]: 17000

In [35]: sbet.get_offset(50)
Out[35]: 6800

In [36]:
```

```
 91 # Use the pprint function from the p
 92 from pprint import pprint
 93
 94 field_names = ('time', 'latitude', '
 95           'x_vel', 'y_vel', 'z_vel',
 96           'roll', 'pitch', 'platform
 97           'x_acceleration', 'y_accel
 98           'x_angular_rate', 'y_angul
 99
100 def decode(data):
101     'Decipher a SBET datagram from b
102     values = struct.unpack('17d',dat
103
104     sbet_values = dict(zip (field_na
105
```

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Rescan
Variables
Functions
Imports
Code

num_datagrams()
get_offset()
decode()
main()

```
          'x_acceleration', 'y
          'x_angular_rate', 'y                    z_acceleration', \

datagram_size = 136 # 8*17 byt

def num_datagrams(data):
    'How many packets are in data'

    assert( len(data) % datagram_size == 0 )

    return len(data) / datagram_size

def get_offset(datagram_number):
    'Calculate the starting offset of a datagram.  First datagram is number 0'
    return datagram_number * datagram_size
```

-U:--- sbet.py 22% L19 [#,r] (Python yas)----------

```
#+END_SRC

* Now we can change main to loop through our datagrams

Change the =main= function to look like this after the read:

#+BEGIN_SRC python
def main():
    print 'Starting main'
    sbet_file = open('sample.sbet')
    sbet_data = sbet_file.read()

    # New code starts here
    print 'Number of datagrams:', num_datagrams(sbet_data)

    print 'Datagram Number, Time, x, y'
```

--:--- 23-python-binary-files-part-3.org 57% L229 [#,r] (Org)----------

researchtools@… [researchtools@… emacs23@ubuntu Index of /~schwe… schwehr / resear…

Wednesday, November 23, 11

Applications Places System 11:52 AM researchtools

schwehr / researchtools / source –

File Edit View History Bookmarks Tools

schwehr / researchtools / sour...

researchtools@ubuntu: ~/clas

File Edit View Search Terminal Hel

```
In [31]: reload sbet
-------> reload(sbet)
Out[31]: <module 'sbet' from 'sbet.p

In [32]: sbet.get_offset(0)
Out[32]: 0

In [33]: sbet.get_offset(1)
Out[33]: 136

In [34]: sbet.get_offset(125)
Out[34]: 17000

In [35]: sbet.get_offset(50)
Out[35]: 6800

In [36]:
```

```
 91 # Use the pprint function from the p
 92 from pprint import pprint
 93
 94 field_names = ('time', 'latitude', '
 95           'x_vel', 'y_vel', 'z_vel',
 96           'roll', 'pitch', 'platform
 97           'x_acceleration', 'y_accel
 98           'x_angular_rate', 'y_angul
 99
100 def decode(data):
101     'Decipher a SBET datagram from b
102     values = struct.unpack('17d',dat
103
104     sbet_values = dict(zip (field_na
105
```

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```
    return sbet_values

def main():
    print 'Starting main'
    sbet_file = open('sample.sbet')
    sbet_data = sbet_file.read()

    print 'Read this many bytes:', len(sbet_data)

    datagram = decode(sbet_data)
    # Use the pprint function from the pprint module
    pprint(datagram)

    print 'Finish main'
```

-U:--- **sbet.py** 73% L45 [#,r] (Python yas)----------

```
#+END_SRC

* Now we can change main to loop through our datagrams

Change the =main= function to look like this after the read:

#+BEGIN_SRC python
def main():
    print 'Starting main'
    sbet_file = open('sample.sbet')
    sbet_data = sbet_file.read()

    # New code starts here
    print 'Number of datagrams:', num_datagrams(sbet_data)

    print 'Datagram Number, Time, x, y'
```

--:--- **23-python-binary-files-part-3.org** 57% L233 [#,r] (Org)----------

Mark set

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Delete from the “print ‘Read this many” down to the end of the main function.

Applications Places System 11:52 AM researchtools

schwehr / researchtools / source –

File Edit View History Bookmarks Tools

schwehr / researchtools / sour...

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File Edit View Search Terminal Hel

```
In [31]: reload sbet
-------> reload(sbet)
Out[31]: <module 'sbet' from 'sbet.p

In [32]: sbet.get_offset(0)
Out[32]: 0

In [33]: sbet.get_offset(1)
Out[33]: 136

In [34]: sbet.get_offset(125)
Out[34]: 17000

In [35]: sbet.get_offset(50)
Out[35]: 6800

In [36]:
```

```
 91 # Use the pprint function from the p
 92 from pprint import pprint
 93
 94 field_names = ('time', 'latitude', '
 95           'x_vel', 'y_vel', 'z_vel',
 96           'roll', 'pitch', 'platform
 97           'x_acceleration', 'y_accel
 98           'x_angular_rate', 'y_angul
 99
100 def decode(data):
101     'Decipher a SBET datagram from b
102     values = struct.unpack('17d',dat
103
104     sbet_values = dict(zip (field_na
105
```

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```
    print 'Read this many bytes:', len(sbet_data)

    datagram = decode(sbet_data)
    # Use the pprint function from the pprint module
    pprint(datagram)

    print 'Finish main'

if __name__ == '__main__':
    print 'starting to run script...'
    main()
    print 'script done!'
```

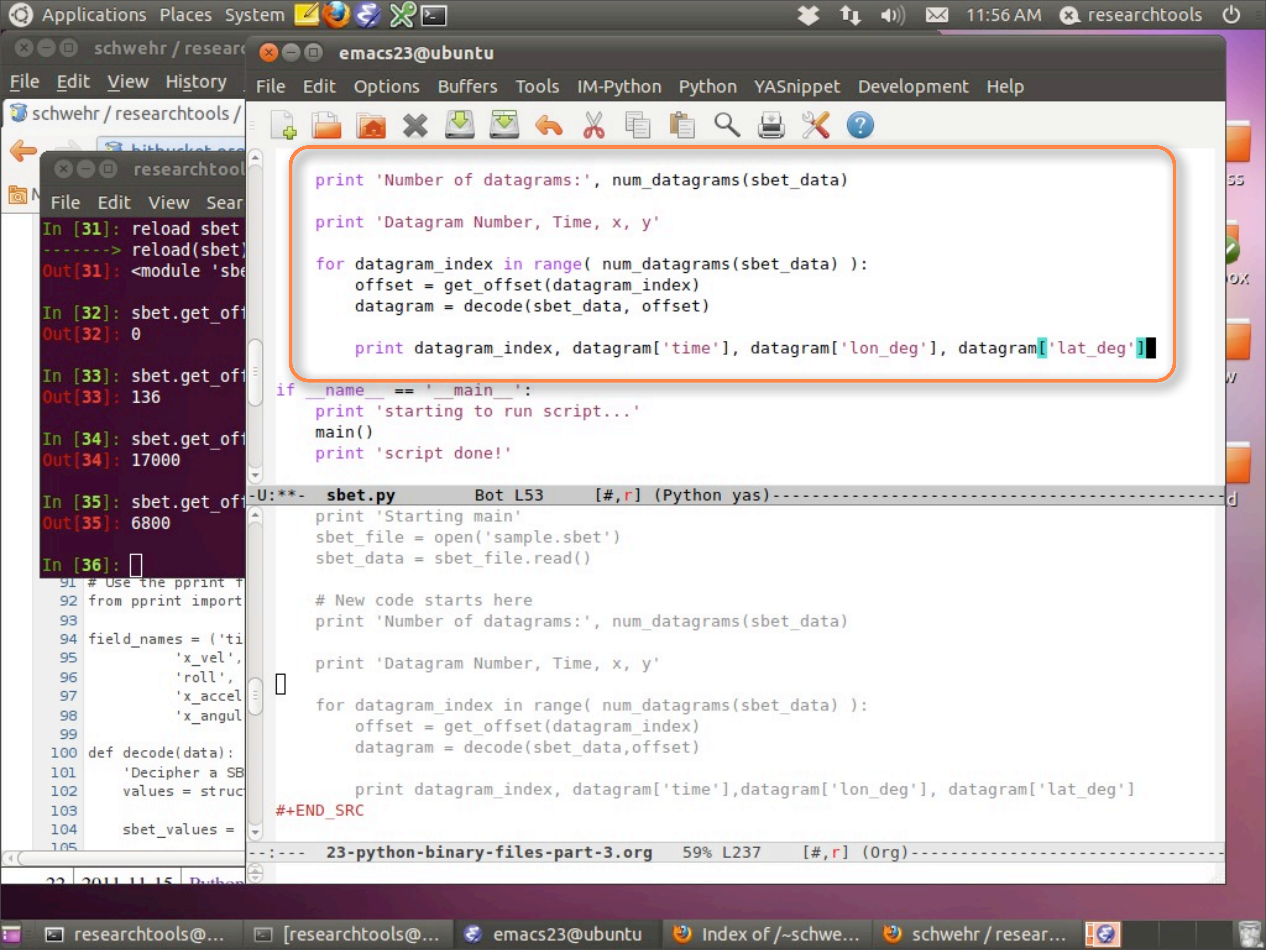
-U:--- sbet.py Bot L52 [#,r] (Python yas)----------

```
#+END_SRC

* Now we can change main to loop through our datagrams

Change the =main= function to look like this after the read:

#+BEGIN_SRC python
def main():
    print 'Starting main'
    sbet_file = open('sample.sbet')
    sbet_data = sbet_file.read()

    # New code starts here
    print 'Number of datagrams:', num_datagrams(sbet_data)

    print 'Datagram Number, Time, x, y'
```

--:--- 23-python-binary-files-part-3.org 57% L233 [#,r] (Org)----------

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11



Wednesday, November 23, 11

Add the code in the highlighted block to the main function.

Applications Places System 11:57 AM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

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File Edit Options Buffers Tools Org Tbl Development Help

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File Edit View Search Terminal Help

```
In [36]: reload sbet
-------> reload(sbet)
Out[36]: <module 'sbet' from 'sbet.py'>

In [37]: run sbet
starting to run script...
Starting main
Number of datagrams: 167
Datagram Number, Time, x, y
0 334959.004823 -146.675232704 60.4443123064
1 335009.003514 -146.671920256 60.448698066
2 335059.002204 -146.667715067 60.4528836831
3 335109.000894 -146.663165536 60.4570416942
4 335158.999585 -146.659085911 60.4612950577
5 335208.998275 -146.654515522 60.4654683305
6 335258.996965 -146.650207253 60.4696697568
7 335308.995656 -146.645977489 60.473902636
```

```
91 # Use the pprint f
92 from pprint import
93
94 field_names = ('ti
95             'x_vel',
96             'roll',
97             'x_accel
98             'x_angul
99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
        datagram = decode(sbet_data,offset)

        print datagram_index, datagram['time'],datagram['lon_deg'], datagram['lat_deg']
#+END_SRC

Run it!

#+BEGIN_EXAMLE
In [32]: run sbet
starting to run script...
Starting main
Number of datagrams: 167
Datagram Number, Time, x, y
```

--:--- 23-python-binary-files-part-3.org 62% L248 [#,r] (Org)

'lat_deg']

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 12:02 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

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```
In [36]: reload sbet
-------> reload(sbet)
Out[36]: <module 'sbe

In [37]: run sbet
starting to run scrip
Starting main
Number of datagrams:
Datagram Number, Time
0 334959.004823 -146.
1 335009.003514 -146.
2 335059.002204 -146.
3 335109.000894 -146.
4 335158.999585 -146.
5 335208.998275 -146.
6 335258.996965 -146.
7 335308.995656 -146.
```

```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95           'x_vel',
 96           'roll',
 97           'x_accel
 98           'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

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```
    sbet_values['lat_deg'] = math.degrees(sbet_values['latitude'])
    sbet_values['lon_deg'] = math.degrees(sbet_values['longitude'])

    return sbet_values

def load_sbet_file(filename):
    '''This is a GENERATOR that we can loop over with a for'''
    sbet_file = open(filename)
    sbet_data = sbet_file.read()

    for datagram_index in range( num_datagrams(sbet_data) ):
        offset = get_offset(datagram_index)
        datagram = decode(sbet_data, offset)
        datagram['index'] = datagram_index
        yield datagram
```

-U:--- sbet.py 48% L50 [#,r] (Python yas)

it makes looping over files and data super easy to do.

Add this function to your sbet.py:

```
#+BEGIN_SRC python
def load_sbet_file(filename):
    '''This is a GENERATOR that we can loop over with a for'''
    sbet_file = open(filename)
    sbet_data = sbet_file.read()

    for datagram_index in range( num_datagrams(sbet_data) ):
        offset = get_offset(datagram_index)
        datagram = decode(sbet_data,offset)
        datagram['index'] = datagram_index
        yield datagram  # <-- the is the magic
```

--:--- 23-python-binary-files-part-3.org 75% L291 [#,r] (Org)

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 12:04 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Development Help

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```
script done!

In [38]:

In [39]: reload sbet
-------> reload(sbet)
Out[39]: <module 'sbet' from 'sbet.py'>

In [40]: sample = sbet.load_sbet_file('sample.sbet')

In [41]: type(sample)
Out[41]: <type 'generator'>

In [42]: print sample
<generator object load_sbet_file at 0x894543c>

In [43]:
```

```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95           'x_vel',
 96           'roll',
 97           'x_accel
 98           'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
# <type 'generator'>

# print sample
<generator object load_sbet_file at 0xa08c7ac>

sample. # Press tab to see options

sample.next()

datagram = sample.next()

# use the special "p" shortcut in ipython for print
p datagram
```

--:--- 23-python-binary-files-part-3.org 82% L313 [#,r] (Org)

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Applications Places System 12:05 PM researchtools

schwehr / researc

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schwehr / researchtools /

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```
Out[41]: <type 'generator'>

In [42]: print sample
<generator object load_sbet_file at 0x894543c>

In [43]: sample.
sample.__class__          sample.__new__          sample.gi_code
sample.__delattr__        sample.__reduce__       sample.gi_frame
sample.__doc__            sample.__reduce_ex__    sample.gi_running
sample.__format__         sample.__repr__         sample.next
sample.__getattribute__   sample.__setattr__      sample.sbet
sample.__hash__           sample.__sizeof__       sample.send
sample.__init__           sample.__str__          sample.throw
sample.__iter__           sample.__subclasshook__
sample.__name__           sample.close

In [43]: sample.next()
```

```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95             'x_vel',
 96             'roll',
 97             'x_accel
 98             'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
# <type 'generator'>

# print sample
<generator object load_sbet_file at 0xa08c7ac>

sample. # Press tab to see options

sample.next()

datagram = sample.next()

# use the special "p" shortcut in ipython for print
p datagram
```

--:--- 23-python-binary-files-part-3.org 82% L313 [#,r] (Org)----------

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 12:06 PM researchtools

schwehr / researc

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schwehr / researchtools /

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```
 'y_vel': 0.998228318178983,
 'z_acceleration': 0.07018300645653144,
 'z_angular': -0.006807197876212325,
 'z_vel': 0.182828045366640 27}

In [44]: datagram = sample.next()

In [45]: p datagram
{'x_acceleration': 0.08870342742214299, 'x_angular_rate': 0.0190324615783965 36, 'platform_heading':
-0.11983325341143347, 'y_angular_rate': 0.07630558594581809, 'pitch': 0.10407820924439941, 'index':
1, 'altitude': 12.729973781043853, 'z_vel': 0.24914099939432371, 'lat_deg': 60.448698066018224, 'lon
gitude': -2.559907928689193, 'roll': 0.006418474606643 03, 'y_vel': 1.287703038920362, 'y_acceleratio
n': 0.0760796143337559, 'time': 335009.00351352885, 'latitude': 1.05502880979594 66, 'lon_deg': -146.
67192025596728, 'z_acceleration': -1.7432651377303723, 'z_angular': 0.00311122924 1529141, 'x_vel': 1
0.424048525788034, 'wander_angle': -0.402191571464519 67}

In [46]: datagram = sample.next()
```

```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95             'x_vel',
 96             'roll',
 97             'x_accel
 98             'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
# print sample
<generator object load_sbet_file at 0xa08c7ac>

sample. # Press tab to see options

sample.next()

datagram = sample.next()

# use the special "p" shortcut in ipython for print
p datagram

sample.next()
```

--:--- 23-python-binary-files-part-3.org 83% L315 [#,r] (Org)

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 12:07 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Development Help

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```
 'x_angular_rate': -0.018349126641222284,
 'x_vel': 10.534199831692101,
 'y_acceleration': -0.273801867022176 46,
 'y_angular_rate': -0.030499856395247778,
 'y_vel': -0.7169424553980409,
 'z_acceleration': 0.5650814424664047,
 'z_angular': -0.009095631575741477,
 'z_vel': -0.062311680809770 78}

In [53]:

In [54]:

In [55]:

In [56]: for sample in sbet.load_sbet_file('sample.sbet'):
   ....:     print sample
```

```
91 # Use the pprint f
92 from pprint import
93
94 field_names = ('ti
95             'x_vel',
96             'roll',
97             'x_accel
98             'x_angul
99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

#+END_SRC

Now try it in a for loop:

```
#+BEGIN_SRC python
# This will print a lot of junk to the screen!
for sample in sbet.load_sbet_file('sample.sbet'):
   print sample

# Nicer:
for sample in sbet.load_sbet_file('sample.sbet'):
    print sample['lon_deg'], sample['lat_deg']
-146.675232704 60.4443123064
```

--:--- 23-python-binary-files-part-3.org 85% L326 [#,r] (Org)

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 12:09 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Development Help

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```
 166, 'altitude': 14.201309297467402, 'z_vel': 0.055766208100356936, 'lat_deg': 60.437070513780455,
'longitude': -2.5602616666206695, 'roll': -0.008158210566226 87, 'y_vel': 1.38402482945318 83, 'y_acce
leration': -0.07966461614949233, 'time': 343258.78745313035, 'latitude': 1.0548258707254499, 'lon_de
g': -146.69218794649456, 'z_acceleration': 0.246302989312507 66, 'z_angular': -0.010615377109340381,
'x_vel': -8.4223789947842, 'wander_angle': -0.390418944719532 15}

In [57]: for sample in sbet.load_sbet_file('sample.sbet'):
    print sample['lon_deg'], sample['lat_deg']
   ....:
   ....:
-146.675232704 60.4443123064
-146.671920256 60.448698066
-146.667715067 60.4528836831
-146.663165536 60.4570416942
-146.659085911 60.4612950577
-146.654515522 60.4654683305
-146.650207253 60.4696697568
```

```
# Use the pprint f
from pprint import

field_names = ('ti
              'x_vel',
              'roll',
              'x_accel
              'x_angul

def decode(data):
    'Decipher a SB
    values = struc

    sbet_values =
```

```
-146.659085911 60.4612950577
-146.654515522 60.4654683305
# ... and lots more ...

# Better would be to save the data to a variable
data = [ ]
for sample in sbet.load_sbet_file('sample.sbet'):
    data.append( [ sample['lon_deg'], sample['lat_deg'] ] )

whos list

data[0]
data[-1]
```

--:--- 23-python-binary-files-part-3.org 89% L342 [#,r] (Org)----------

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 12:11 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Development Help

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
In [60]: data = [ ]

In [61]: for sample in sbet.load_sbet_file('sample.sbet'):
    data.append( [ sample['lon_deg'], sample['lat_deg']  ] )
   ....:
   ....:

In [63]: whos list
Variable   Type    Data/Info
--------------------------
data       list    [[-146.6752327043359, 60.<...>456, 60.437070513780455]]

In [64]: data[0]
Out[64]: [-146.6752327043359, 60.444312306421736]

In [65]: data[-1]
```

```
# Use the pprint f
from pprint import

field_names = ('ti
              'x_vel',
              'roll',
              'x_accel
              'x_angul

def decode(data):
    'Decipher a SB
    values = struc

    sbet_values =
```

```
-146.659085911 60.461295077
-146.654515522 60.4654683305
# ... and lots more ...

# Better would be to save the data to a variable
data = [ ]
for sample in sbet.load_sbet_file('sample.sbet'):
    data.append( [ sample['lon_deg'], sample['lat_deg'] ] )

whos list

data[0]
data[-1]
```

--:--- 23-python-binary-files-part-3.org 89% L342 [#,r] (Org)

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 12:13 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

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researchtools@ubuntu: ~/class/23

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```
In [67]: whost list
------------------------------------------------------------
   File "<ipython console>", line 1
     whost list
              ^
SyntaxError: invalid syntax


In [68]: whos list
Variable   Type    Data/Info
--------------------------
data       list    []

In [69]: for sample in sbet.load_sbet_file('sample.sbet'):
    data.append( sample )
   ....:
```

```
91 # Use the pprint f
92 from pprint import
93
94 field_names = ('ti
95             'x_vel',
96             'roll',
97             'x_accel
98             'x_angul
99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

=dict= (dictionary) in a list and then make an =array= for each parameter.

```
#+BEGIN_SRC python
data = [ ]

for sample in sbet.load_sbet_file('sample.sbet'):
    data.append( sample )

whos

x_list = [ ]

for sample in data:
```

--:--- 23-python-binary-files-part-3.org 93% L356 [#,r] (Org)----------

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researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 12:14 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Development Help

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
In [69]: for sample in sbet.load_sbet_file('sample.sbet'):
    data.append( sample )
   ....:
   ....:

In [71]: whos list
Variable   Type    Data/Info
---------------------------
data       list    [{'x_acceleration': -0.82<...>': -0.39041894471953215}]

In [72]: data[0]['lon_deg']
Out[72]: -146.6752327043359

In [73]: x_list = [ ]

In [74]: for sample in data:
   ....:     x_list.append( sample['lon_deg']  )
```

```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95           'x_vel',
 96           'roll',
 97           'x_accel
 98           'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
whos

x_list = [ ]

for sample in data:
    x_list.append(sample['lon_deg'])

import numpy
x = numpy.array(x_list)

from matplotlib import pyplot
pyplot.interactive(True)
pyplot.plot(x)
```

--:--- 23-python-binary-files-part-3.org 95% L366 [#,r] (Org)

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Applications Places System 12:15 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Development Help

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
In [74]: for sample in data:
   ....:     x_list.append( sample['lon_deg']  )
   ....:
   ....:

In [75]: whos list
Variable   Type    Data/Info
---------------------------
data       list    [{'x_acceleration': -0.82<...>': -0.390418944719532 15}]
x_list     list    [-146.67523270433 59, -146<...>086, -146.69218794649456]

In [76]: import numpy

In [77]: x = numpy.array(x_list)

In [78]: psearch x*
```

```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95             'x_vel',
 96             'roll',
 97             'x_accel
 98             'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
whos

x_list = [ ]

for sample in data:
    x_list.append(sample['lon_deg'])

import numpy
x = numpy.array(x_list)

from matplotlib import pyplot
pyplot.interactive(True)
pyplot.plot(x)
```

--:--- 23-python-binary-files-part-3.org 95% L366 [#,r] (Org)

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

"psearch x*" means that we want to look for all the variables and functions that start with the letter "x"

Applications Places System 12:16 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ubuntu

File Edit Options Buffers Tools Org Tbl Development Help

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
sbet            module      <module 'sbet' from 'sbet.py'>
sbet_data       str         [illegible]
sbet_file       file        <open file 'sample.sbet', mode 'r' at 0x88ae8b8>
struct          module      <module 'struct' from '/u<...>ib/python2.7/struct.pyc'>
x               ndarray     167: 167 elems, type `float64`, 1336 bytes
x_list          list        [-146.6752327043359, -146<...>086, -146.69218794649456]

In [80]: whos ndarray
Variable   Type       Data/Info
------------------------------
x          ndarray    167: 167 elems, type `float64`, 1336 bytes

In [81]: from matplotlib import pyplot

In [82]: pyplot.interactive(True)

In [83]: pyplot.plot(x)
```

```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95             'x_vel',
 96             'roll',
 97             'x_accel
 98             'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
whos

x_list = [ ]

for sample in data:
    x_list.append(sample['lon_deg'])

import numpy
x = numpy.array(x_list)

from matplotlib import pyplot
pyplot.interactive(True)
pyplot.plot(x)
```

--:--- 23-python-binary-files-part-3.org 95% L366 [#,r] (Org)

researchtools@... [researchtools@... emacs23@ubuntu Index of /~schwe... schwehr / resear...

Wednesday, November 23, 11

Applications Places System 12:17 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ub

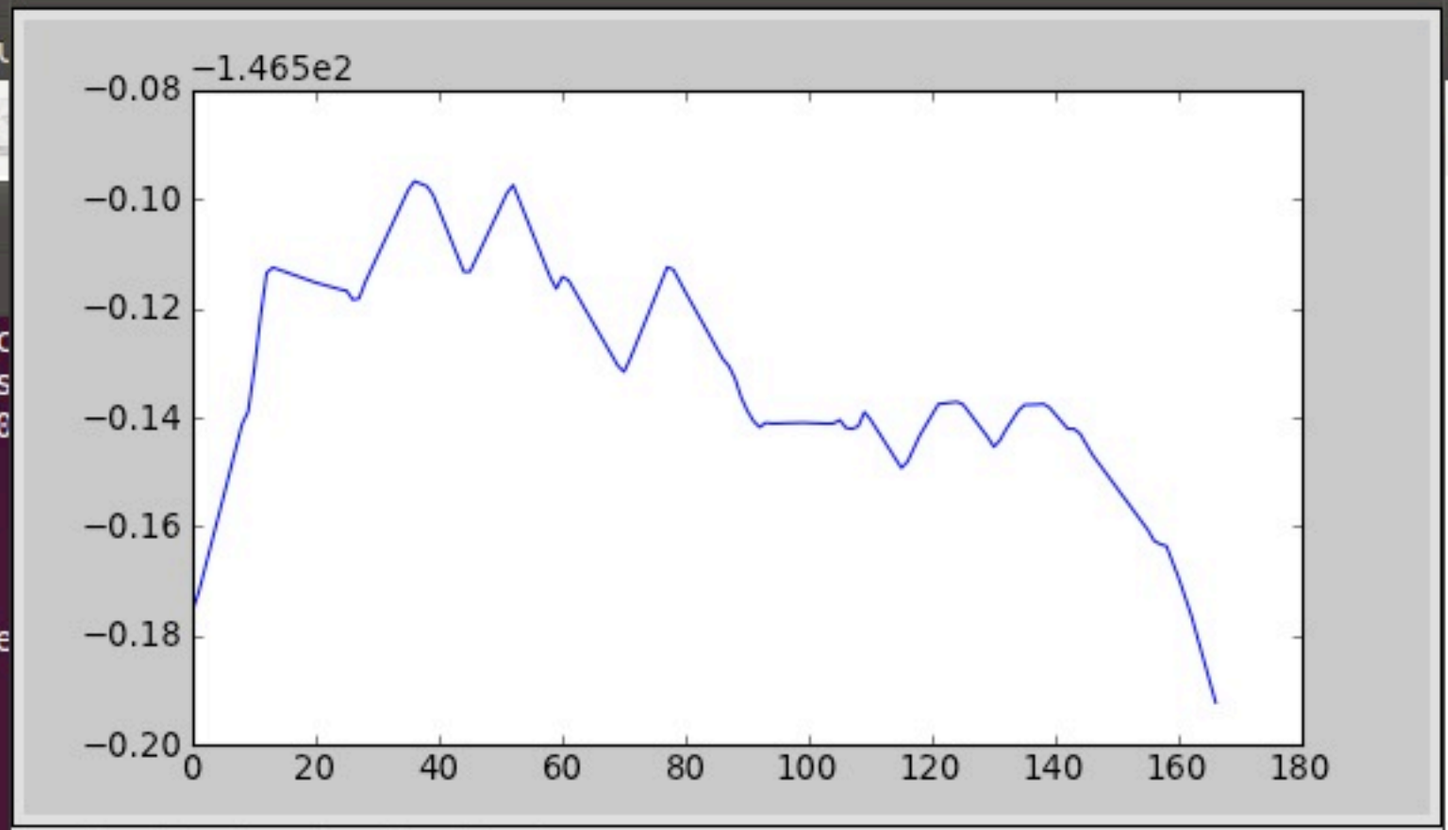
File Edit Options Bu

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
struct          module      <module 'struc
x               ndarray     167: 167 elems
x_list          list        [-146.67523270

In [80]: whos ndarray
Variable   Type       Data/Info
------------------------------
x          ndarray    167: 167 elems, type

In [81]: from matplotlib import pyplot

In [82]: pyplot.interactive(True)

In [83]: pyplot.plot(x)
Out[83]: [<matplotlib.lines.Line2D object at 0x9063e0c>]

In [84]:
```

Figure 1




```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95           'x_vel',
 96           'roll',
 97           'x_accel
 98           'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
whos

x_list = [ ]

for sample in data:
    x_list.append(sample['lon_deg'])

import numpy
x = numpy.array(x_list)

from matplotlib import pyplot
pyplot.interactive(True)
pyplot.plot(x)
```

--:--- 23-python-binary-files-part-3.org 95% L366 [#,r] (Org)----------

researchtool... [researchto... emacs23@u... Index of /~sc... schwehr / re... Figure 1

Wednesday, November 23, 11

Applications Places System 12:17 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ub

File Edit Options Bu

Figure 1

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researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
x          ndarray    167: 167 elems, type `float64`, 1336 bytes

In [81]: from matplotlib import pyplot

In [82]: pyplot.interactive(True)

In [83]: pyplot.plot(x)
Out[83]: [<matplotlib.lines.Line2D object at 0x9063e0c>]

In [84]: y_list = [ ]

In [85]: for sample in data:
    y_list.append( sample['lat_deg']  )
   ....:
   ....:

In [87]:
```

```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95           'x_vel',
 96           'roll',
 97           'x_accel
 98           'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

whos

```
x_list = [ ]

for sample in data:
    x_list.append(sample['lon_deg'])

import numpy
x = numpy.array(x_list)

from matplotlib import pyplot
pyplot.interactive(True)
pyplot.plot(x)
```

--:--- 23-python-binary-files-part-3.org 95% L366 [#,r] (Org)----------

researchtool... [researchto... emacs23@u... Index of /~sc... schwehr / re... Figure 1

Applications Places System 12:18 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ub

File Edit Options Bu

Figure 1

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180

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
   ....:
   ....:

In [87]: whos list
Variable   Type    Data/Info
---------------------------
data       list    [{'x_acceleration': -0.82<...>': -0.39041894471953215}]
x_list     list    [-146.6752327043359, -146<...>086, -146.69218794649456]
y_list     list    [60.444312306421736, 60.4<...>7026, 60.437070513780455]

In [88]: y = numpy.arr
numpy.array          numpy.array_equal   numpy.array_repr    numpy.array_str
numpy.array2string   numpy.array_equiv   numpy.array_split

In [88]: y = numpy.array(y_list)

In [89]: whos nda
```

```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95             'x_vel',
 96             'roll',
 97             'x_accel
 98             'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
whos

x_list = [ ]

for sample in data:
    x_list.append(sample['lon_deg'])

import numpy
x = numpy.array(x_list)

from matplotlib import pyplot
pyplot.interactive(True)
pyplot.plot(x)
```

--:--- 23-python-binary-files-part-3.org 95% L366 [#,r] (Org)----------

researchtool... [researchto... emacs23@u... Index of /~sc... schwehr / re... Figure 1

Applications Places System 12:18 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ubuntu

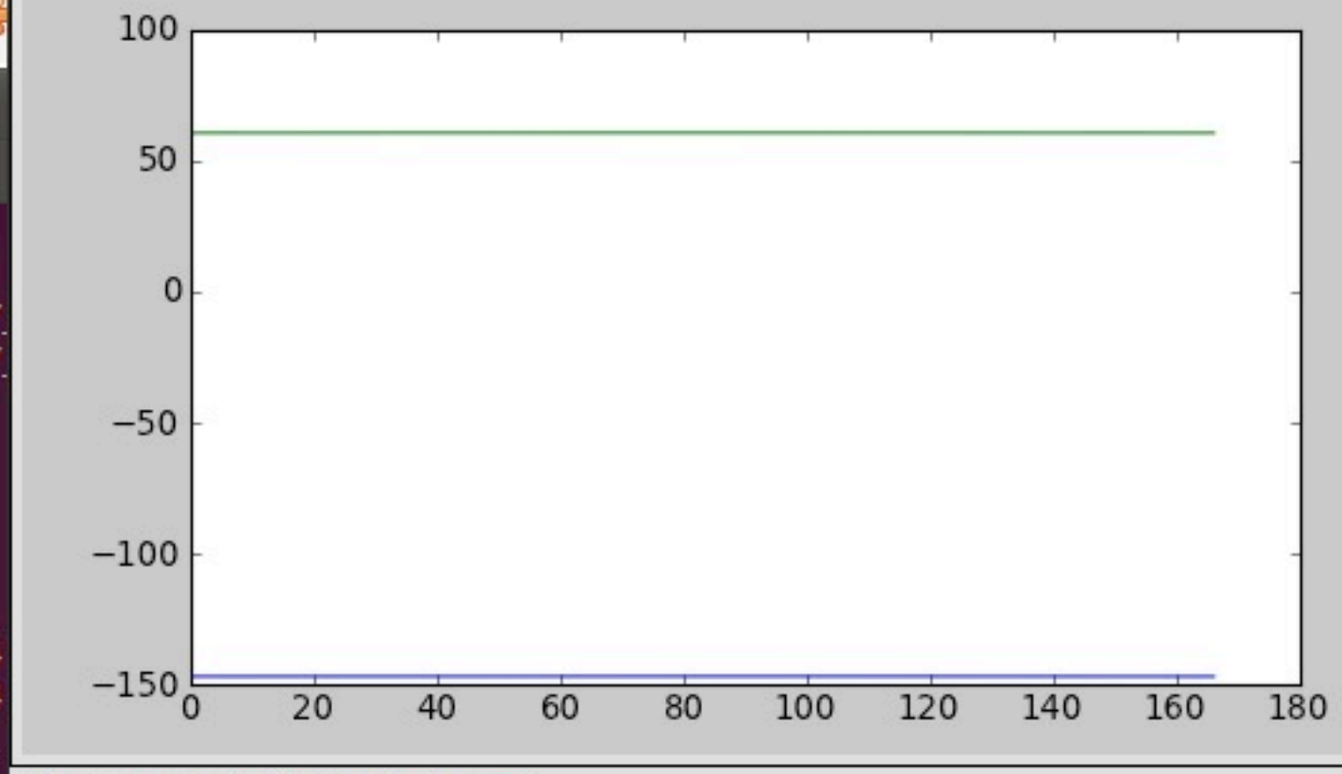
File Edit Options Buffers Tool

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
In [88]: y = numpy.arr
numpy.array          numpy.array_equal   numpy.array
numpy.array2string   numpy.array_equiv   numpy.array

In [88]: y = numpy.array(y_list)

In [89]: whos ndarray
Variable   Type       Data/Info
------------------------------
x          ndarray    167: 167 elems, type `float64
y          ndarray    167: 167 elems, type `float64

In [90]: pyplot.plot(y)
Out[90]: [<matplotlib.lines.Line2D object at 0x92ed

In [91]:
```

Figure 1




```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95             'x_vel',
 96             'roll',
 97             'x_accel
 98             'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
whos

x_list = [ ]

for sample in data:
    x_list.append(sample['lon_deg'])

import numpy
x = numpy.array(x_list)

from matplotlib import pyplot
pyplot.interactive(True)
pyplot.plot(x)
```

--:--- 23-python-binary-files-part-3.org 95% L366 [#,r] (Org)----------

researchtool... [researchto... emacs23@u... Index of /~sc... schwehr / re... Figure 1

Wednesday, November 23, 11

Applications Places System 12:19 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ubuntu

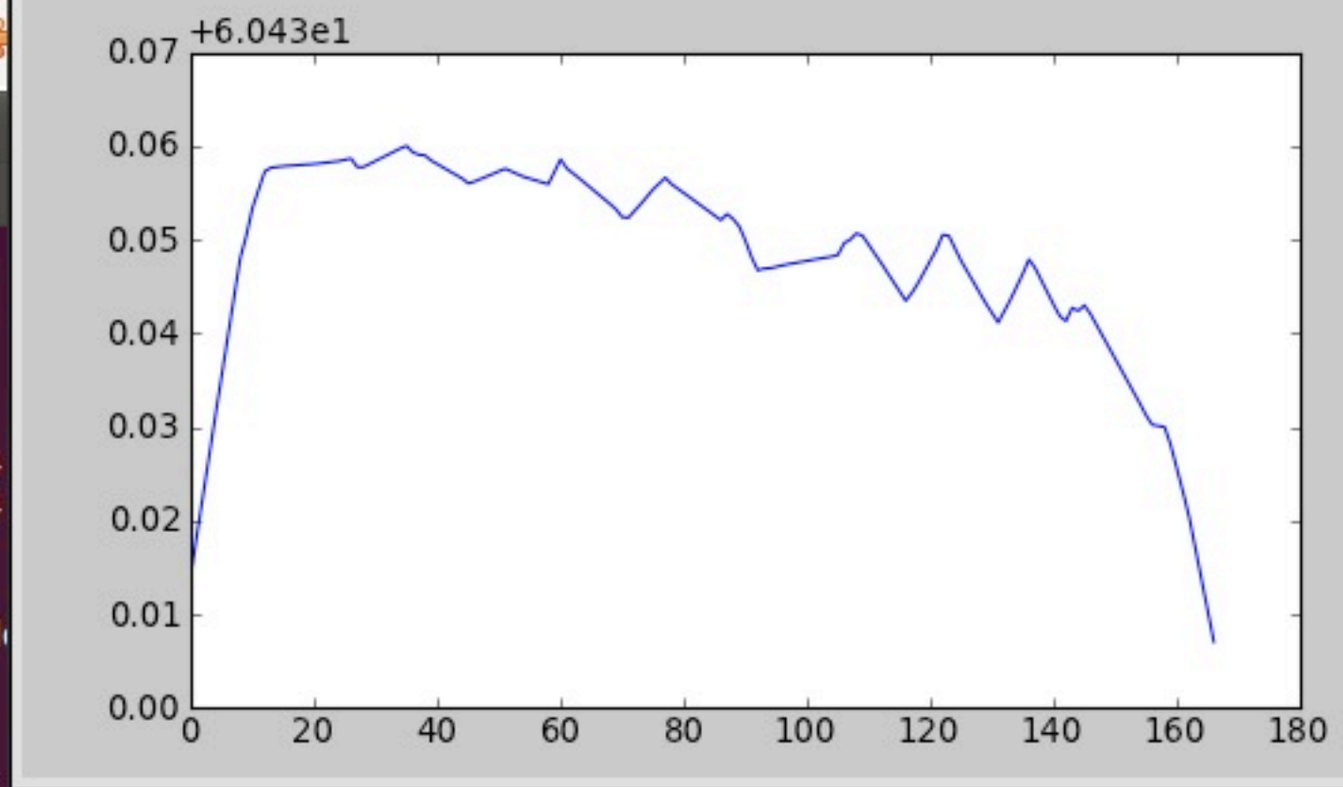
File Edit Options Buffers Tool

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
In [88]: y = numpy.array(y_list)

In [89]: whos ndarray
Variable   Type       Data/Info
------------------------------
x          ndarray    167: 167 elems, type `float64
y          ndarray    167: 167 elems, type `float64

In [90]: pyplot.plot(y)
Out[90]: [<matplotlib.lines.Line2D object at 0x92ed

In [91]: pyplot.cla()

In [92]: pyplot.plot(y)
Out[92]: [<matplotlib.lines.Line2D object at 0x92d7

In [93]:
```

Figure 1



x=4.84721 y=60.4543

```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95             'x_vel',
 96             'roll',
 97             'x_accel
 98             'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
x = numpy.array(x_list)

from matplotlib import pyplot
pyplot.interactive(True)
pyplot.plot(x)

for sample in data:
    y_list.append(sample['lat_deg'])

y = numpy.array(y_list)

pyplot.cla()
pyplot.plot(y)
```

--:--- 23-python-binary-files-part-3.org 97% L380 [#,r] (Org)----------

researchtool... [researchto... emacs23@u... Index of /~sc... schwehr / re... Figure 1

Applications Places System 12:19 PM researchtools

schwehr / researc

File Edit View History

schwehr / researchtools /

emacs23@ubuntu

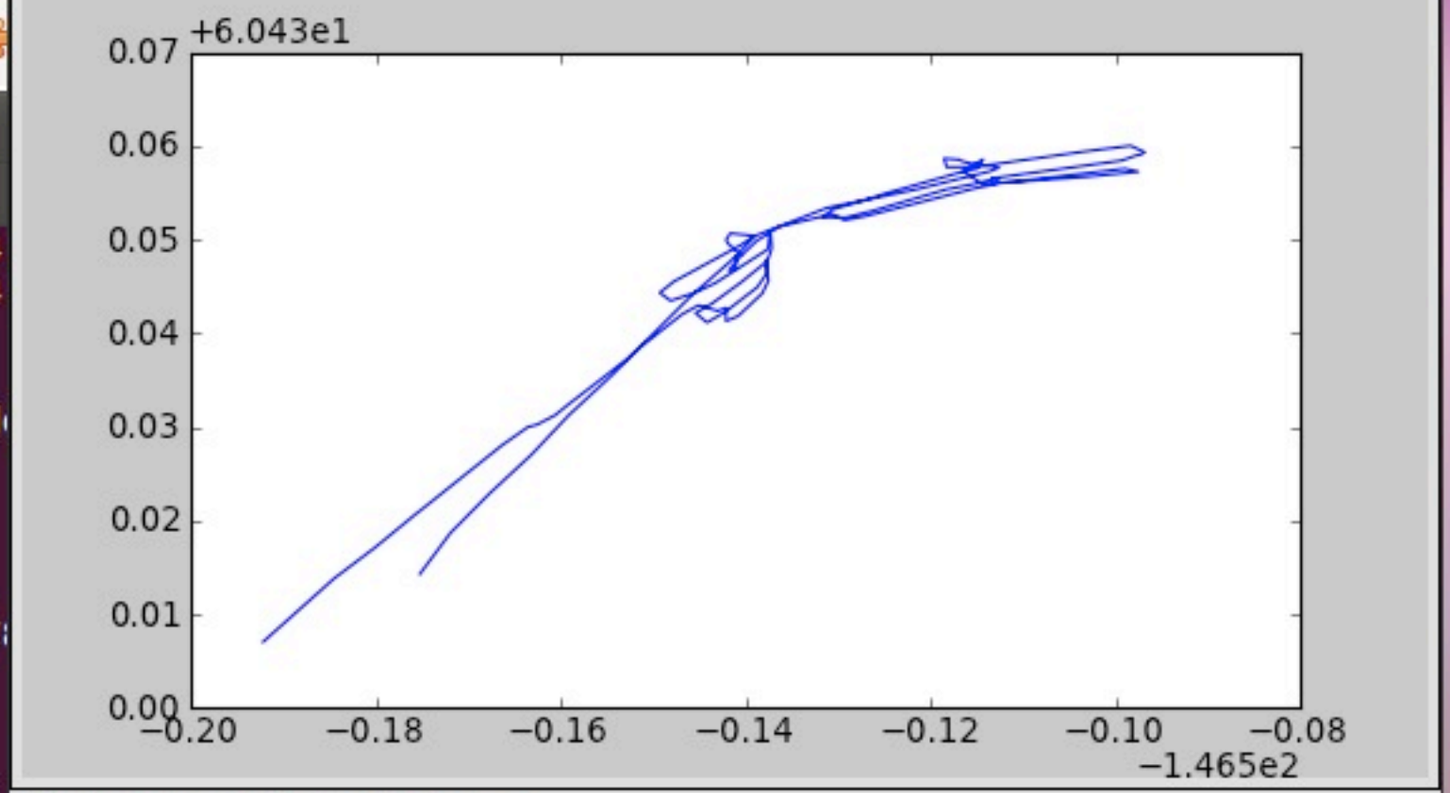
File Edit Options Buffers Tool

researchtools@ubuntu: ~/class/23

File Edit View Search Terminal Help

```
x           ndarray    167: 167 elems, type `float64
y           ndarray    167: 167 elems, type `float64

In [90]: pyplot.plot(y)
Out[90]: [<matplotlib.lines.Line2D object at 0x92ed

In [91]: pyplot.cla()

In [92]: pyplot.plot(y)
Out[92]: [<matplotlib.lines.Line2D object at 0x92d7

In [93]: pyplot.cla()

In [94]: pyplot.plot(x,y)
Out[94]: [<matplotlib.lines.Line2D object at 0x93c4

In [95]:
```

Figure 1

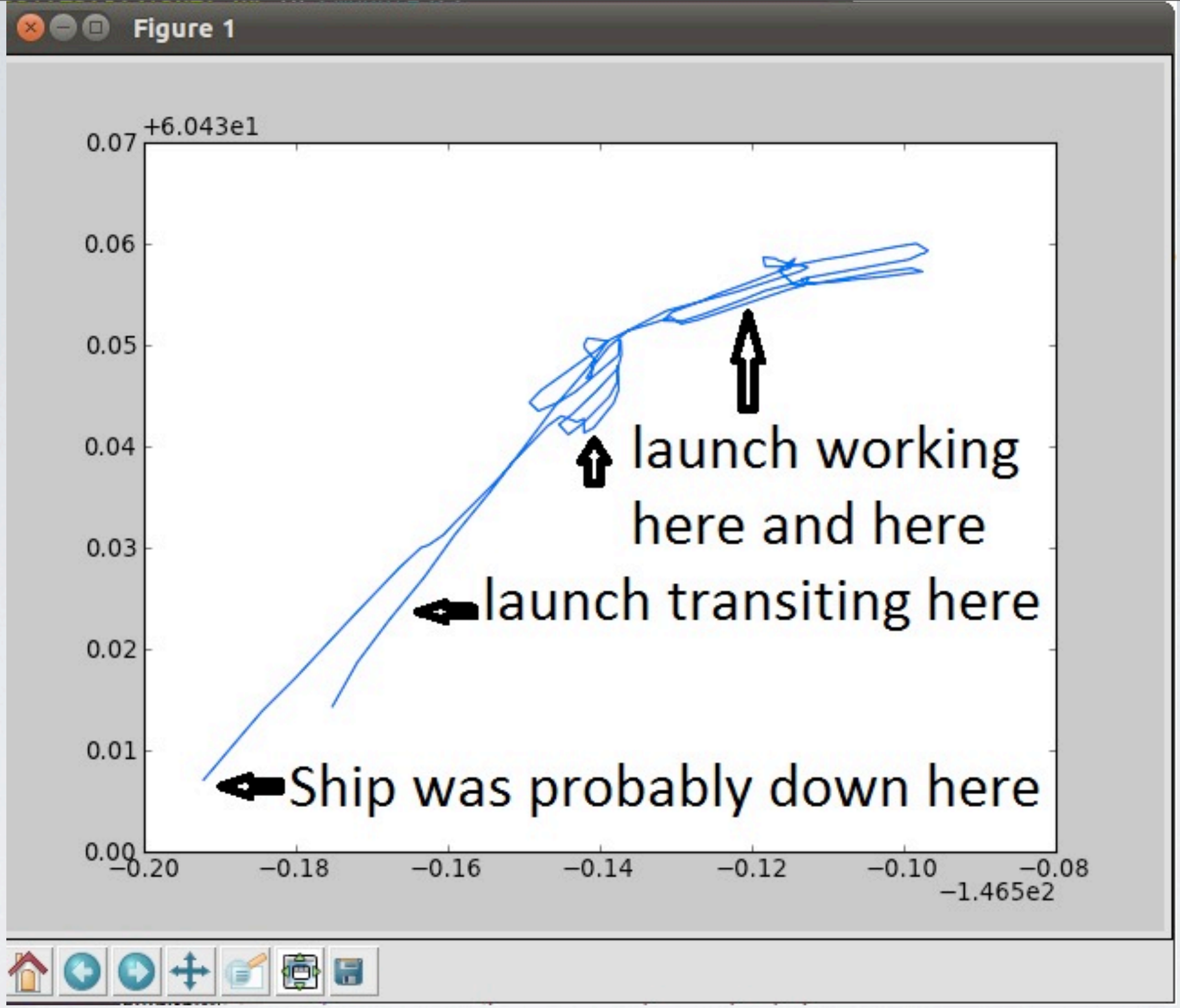



```
 91 # Use the pprint f
 92 from pprint import
 93
 94 field_names = ('ti
 95              'x_vel',
 96              'roll',
 97              'x_accel
 98              'x_angul
 99
100 def decode(data):
101     'Decipher a SB
102     values = struc
103
104     sbet_values =
105
```

```
x = numpy.array(x_list)

from matplotlib import pyplot
pyplot.interactive(True)
pyplot.plot(x)

for sample in data:
    y_list.append(sample['lat_deg'])

y = numpy.array(y_list)

pyplot.cla()
pyplot.plot(y)
```

--:--- 23-python-binary-files-part-3.org 97% L380 [#,r] (Org)----------

researchtool... [researchto... emacs23@u... Index of /~sc... schwehr / re... Figure 1



Annotations of what the launch was likely doing.
Courtesy of Glen Rice.