Using Gnuplot on Linux Platform

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Contents

Chapter 1

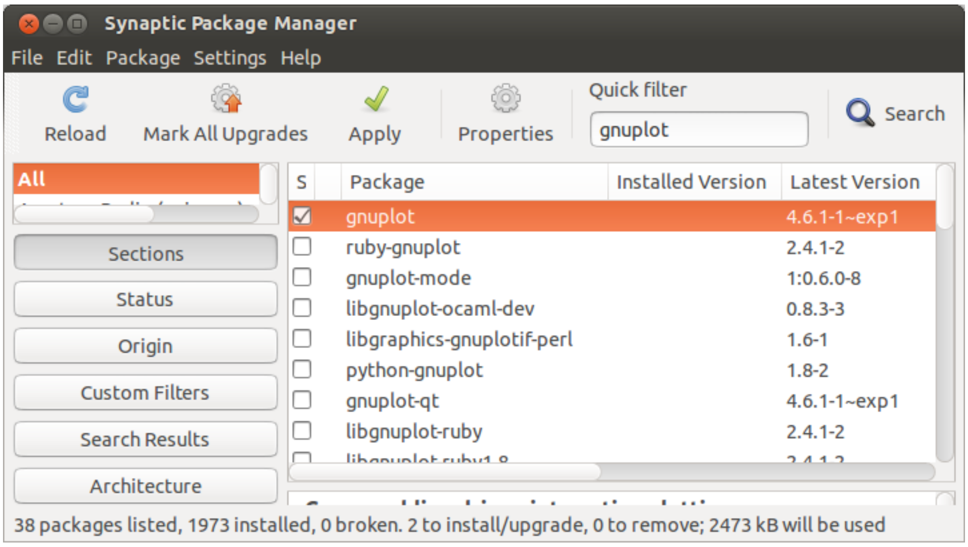
Installation

1.1 Using Terminal

- Open Terminal.
- Type "`sudo apt-get install gnuplot`" and press *Enter*.
- Type "`sudo apt-get install gnuplot-x11`" and press *Enter*.

1.2 Using Synaptic Package Manager

- Open Synaptic Package Manager and type *gnuplot* in *Quick Filter* search.
- Right click on gnuplot package and click *Mark for Installation*.
- Similarly select gnuplot-x11 and click *Mark for Installation*.
- Now install packages by clicking *Apply*.



S	Package	Installed Version	Latest Version
☑	gnuplot		4.6.1-1~exp1
□	ruby-gnuplot		2.4.1-2
□	gnuplot-mode		1:0.6.0-8
□	libgnuplot-ocaml-dev		0.8.3-3
□	libgraphics-gnuplotif-perl		1.6-1
□	python-gnuplot		1.8-2
□	gnuplot-qt		4.6.1-1~exp1
□	libgnuplot-ruby		2.4.1-2
□	libgnuplot-ruby1.8		2.4.1-2

38 packages listed, 1973 installed, 0 broken. 2 to install/upgrade, 0 to remove; 2473 kB will be used

Chapter 2

Using Gnuplot on linux Platform

2.1 Points to note

- GnuPlot ignores lines starting with # (Symbol for comments).
- "**" mean exponent. e.g. "3**4" means 3^4.
- Any file name in command must be mentioned in double quotes. e.g. "file.txt".
-
-

2.2 Plotting data-points from a file

2.2.1 Viewing Plots

Many Computing simulators give output in data files (with *.dat* extension).
Each line in data file specifies one data point which has one independent variable and one or more dependent variable which are seperated by [space] or [Tab].
Here we will plot data points using Gnuplot.

- Open your favorite text editor (e.g. gedit), copy follwing text and save it with *.dat* extension (e.g. *test.dat*) to the prefered directory.

```
#this file contais data points having two dependent variables.
#X ramdom Xsquare
0 0.1 0
1 1.1 1
2 2.1 4
3 3.2 9
4 4.3 16
5 5.5 25
```

- Open terminal and go to the directory (where you saved your file) using *cd* command.

- Type `gnuplot` and press *Enter*.
- When Gnuplot is launched in terminal, the last line should be "*Terminal type set to 'wxt'*" if not, gnuplot-x11 package is not installed properly and hence it will not generate plots.
- Type `plot "test.dat"` and *Enter*. Plot window should pop-out.
- By default, it will plot first two columns, first on X-axis and second on Y-axis.
- Pressing 'l' on keyboard will change Y-axis of plot to *log-scale*.
- Similarely 'a' for autoscale, 'r' for ruler, 'g' for grid, 'b' for border.

2.2.2 Saving the Output file

- Type `set terminal png` and *Enter*

  To get output in png format.

  It can also be set to *gif, jpeg and many more file types*

  For more information, type `set terminal` and press *Enter*.
- Type `set output "out.png"` and *Enter*

  Output will be saved as *out.png* in the same directory after plotting.
- Type `replot` and *Enter*

  You will observe that ranges for x & y axes and legend are automatially generated.

  For any update or modification in plot, only `replot` command is needed.

  Go to the directory and see output (see Figure 2.1 for reference).

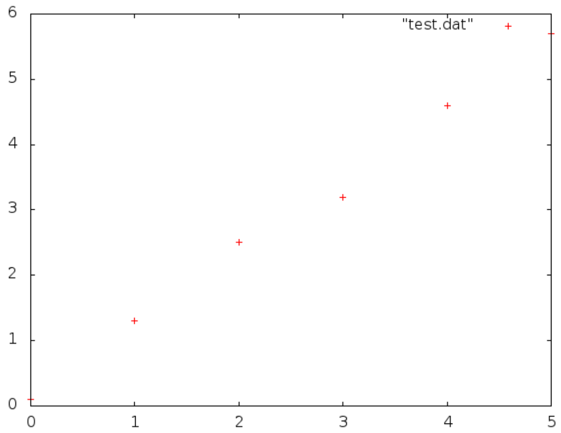


Figure 2.1: Plot of 1st dependent variable

2.2.3 Customizing plot area

Plot area can be modified using following commands and entering `replot` afterwards.

Table 2.1: Modifying plot area

Purpose	Command
To add x-label	`set xlabel "Independent-variable"`
To add y-label	`set ylabel "Dependent-variable"`
To add Title	`set title "plot-title"`
To set sample points	`set samples` n
To set x or y range	`set xrange` [x_1:x_2], `set yrange` [y_1:y_2]
To set grid	`set grid`
To set x tics	`set xtics <start pt>, <increment>, <end pt>`
To set log x scale	`set logscale`
To set log y scale	`unset logscale`; `set logscale y`

- In Figure 2.1, crosspoints are used to denote the datapoints. We can Customize it to impulse plot or line plot or line+point plot etc. also the type of dots and its size can be adjusted.

```
plot "test.dat" with lines
```

  Replace “lines” in above command with “lines linestyle 2 linewidth 3”, “impulse”, “linespoints”, “points pointtype 7 pointsize 2” and play around for more insight.

- To modify position of legend, Try follwing commands.

```
set key left box / set key right nobox / set key reverse Left outside
```

  Following figure shows same plot with modified labels and legend.

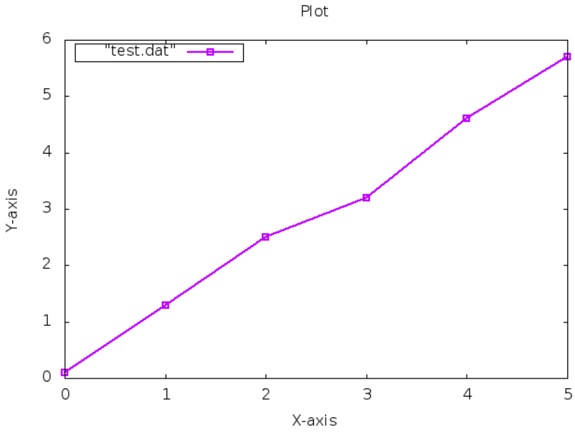


Figure 2.2: Plot after modification

2.2.4 Plotting multiple curves from data file

- Using simple plot command as used above, we were not able to plot multiple dependent variables in data file.
  For that we will use more specific commands as given below.

```
plot "test.dat" using 1:2 title ‘Random’ with linespoints pointtype 3,
"test.dat" using 1:3 title ‘Xsquared’ with line
```

  Term “1:2” means x=1st column and y=2nd column

  Term “1:3” means y=1st column and y=3nd column.

- You may have multiple data files. In this case, you may make use a command like:

```
plot "test1.dat" using 1:2 title ‘Test1-data’ with linespoints pointtype
3,"test2.dat" using 1:3 title ‘Test2-data’ with line
```

- Play with some modifications for proper understanding. See Multiple curves in following figure which shows two dependent variables from data file.

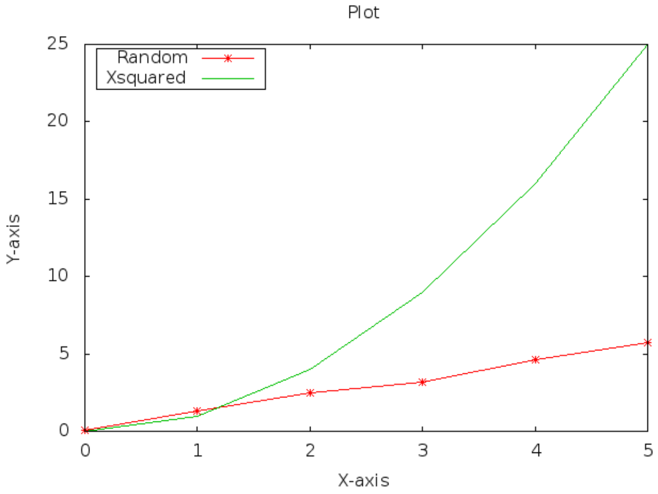


Figure 2.3: Plot of Multiple dependent variable

2.3 Curve fitting

- Curve fitting in data is necessory tool for any plotting software. Gnuplot supports linear as well as nonlinear curve fits.
- Our first column data can be fitted into line $f(x) = a * x + b$.
- To fit it in equation of line, follow the commands one by one:

```
plot "test.dat" using 1:2 title 'Random'
f(x)=m*x+n
fit f(x) "test.dat" using 1:2 via m,n
replot f(x)
```

- For fitting polynomial in second data.

```
plot "test.dat" using 1:3 title 'series-2'
g(x)=a*x**b
fit g(x) "test.dat" using 1:3 via a,b
replot g(x)
```

- After successful fitting, it will show values of m & n or a & b in the terminal.
- If it finds any singularity, then it will give error as "-nan"(it means Not A Number). To resolve it, give initial guess of values of m and n in terminal. e.g. `m=1,n=1` .
  Or add some small value in f(x). e.g. `f(x)=m*x+n+1e-8`.
  If Problem continues, Find other ways (Google :)).
- All graphs can be plotted simultaniously using following command :—>

```
plot "test.dat" using 1:2 title 'series-1', f(x) title 'Fit to series-1',
"test.dat" using 1:3 title 'series-2', g(x) title 'Fit to series-2'
```

- Gnuplot support C-language syntax along with all mathematical formats.
  Variable can be displayed on graph using *sprint* command as shown below.

```
set label 1 sprintf("m = %3.4f",m) at 1,15
set label 2 sprintf("n = %3.4f",n) at 1,13
set label 3 sprintf("a = %3.4f",a) at 1,11
set label 4 sprintf("b = %3.4f",b) at 1,9
replot
```

—> last two numbers seperated by comma shows position of label on graph.

- To save it —>

```
set terminal png
set output "fitted-out.png"
replot
```

- Figure 2.5 shows the obtained plot.

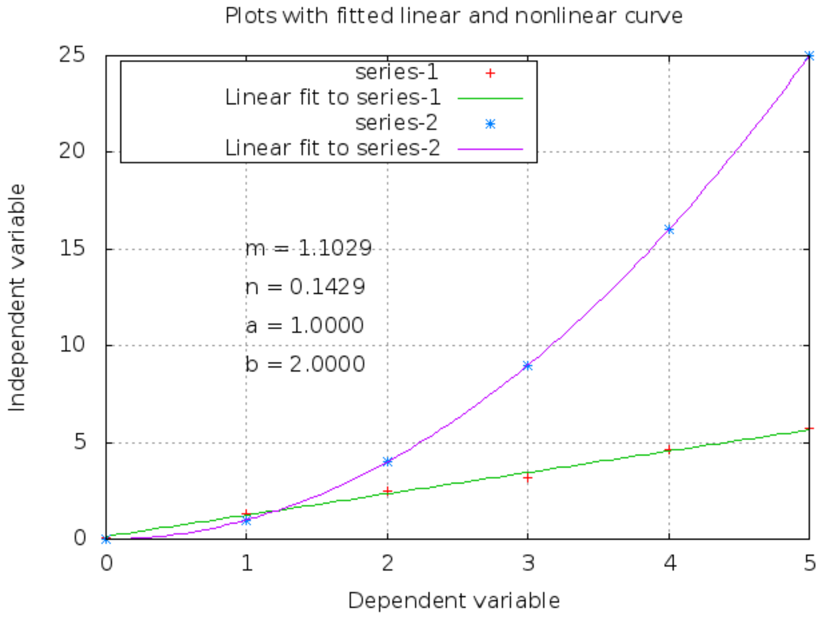


Figure 2.4: Plot of Multiple dependent variable

2.4 Plotting direct functions

2.4.1 Basics

- `plot` is used for 2D graphs and `splot` is used for 3D graphs.
- All standard mathematical expressions are valid for Gnuplot.
  See Examples.

```
set samples 500
set xrange [-20:20]
plot sin(x)/x
```

- output will look like :—>

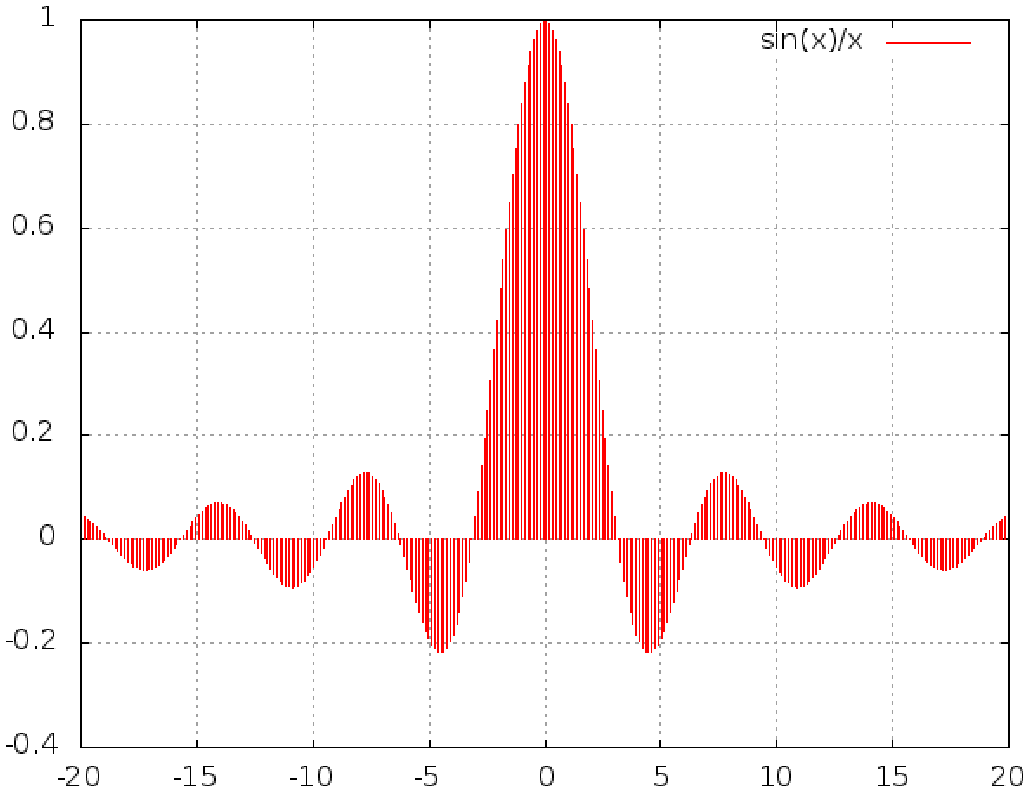


Figure 2.5: Sinc Functin

- For Supported functions see Appendix.
- commands like following are also acceptable.
  `plot [-pi/2:pi] cos(x),-(sin(x) > sin(x+1) ?  sin(x) :  sin(x+1))`

2.4.2 Multiplots

Gnuplot can plot more than one figure in same figure (like subplot in Matlab). Try following commands in terminal one after another:

```
set multiplot
set size 1,0.5
set origin 0.0,0.5; plot sin(x)**2/x
set origin 0.0,0.0; plot real(tan(x)/atan(x))
set grid unset multiplot
```

- In second command,

  (1,0.5) means row is splitted in half. (2 subplots)

  (0.5,0.5) means row and column are splitted in half. (4 subplots)

  (0.25,0.25) means row and column are spitted in four parts. (16 subplots)

- Obtained output is —>

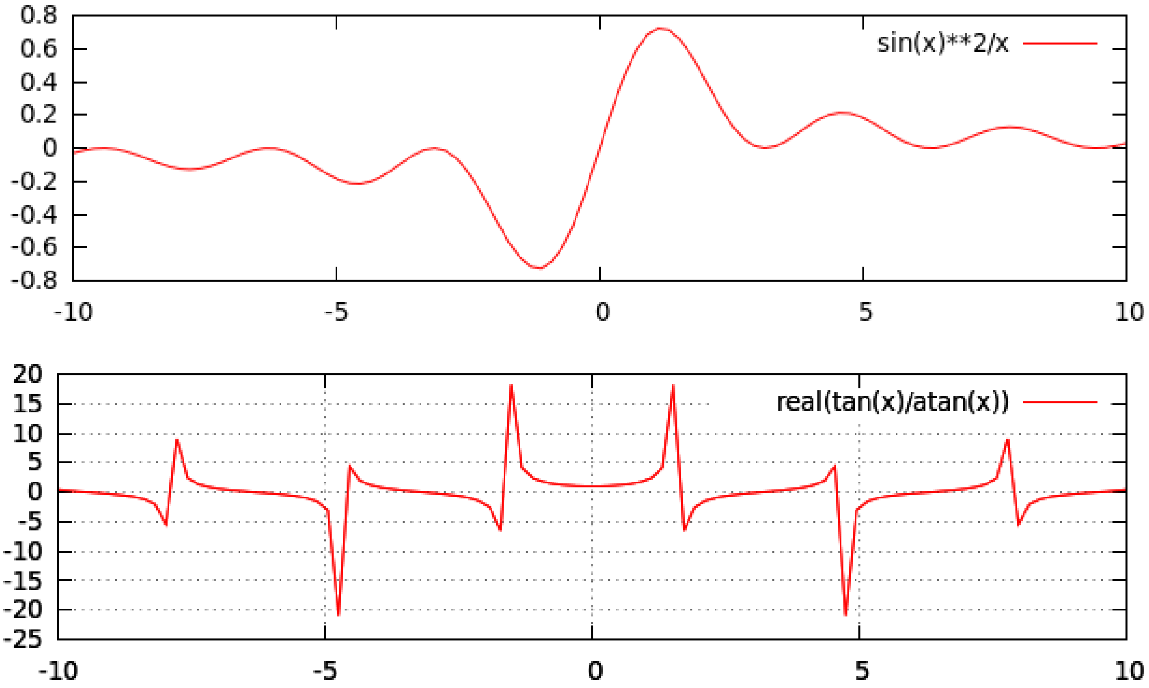


Figure 2.6: Multiplots

Bibliography

The Gnuplot examples —> http://gnuplot.sourceforge.net/demo/
The Gnuplot Manual —> http://www.gnuplot.info/docs_4.6/gnuplot.pdf
The Gnuplot FAQ —> http://www.gnuplot.info/faq/

Appendix A

Supported functions

Table A.1: Supported Functions

Functions	Return
abs(x)	absolute value of x, $|x|$
acos(x)	arc-cosine of x
asin(x)	arc-sine of x
atan(x)	arc-tangent of x
cos(x)	cosine of x, x is in radians.
cosh(x)	hyperbolic cosine of x, x is in radians
erf(x)	error function of x
exp(x)	exponential function of x, base e
inverf(x)	inverse error function of x
invnorm(x)	inverse normal distribution of x
log(x)	log of x, base e
log10(x)	log of x, base 10
norm(x)	normal Gaussian distribution function
rand(x)	pseudo-random number generator
sgn(x)	1 if x > 0, -1 if x < 0, 0 if x=0
sin(x)	sine of x, x is in radians
sinh(x)	hyperbolic sine of x, x is in radians
sqrt(x)	the square root of x
tan(x)	tangent of x, x is in radians
tanh(x)	hyperbolic tangent of x, x is in radians

NOTE:
Bessel, gamma, ibeta, igamma, and lgamma functions are also supported.
Many functions can take complex arguments.
Binary and unary operators are also supported.