

Axis - A program for making two dimensional graphs

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1 General information

Axis is a program for making two dimensional graphs. It features automatic scaling, logarithmic axes, error bars, and labels with Greek letters, superscripts and subscripts, and special characters. The output of axis is a file using a subset of the UNIX device independent graphics commands, which can then be plotted on any device for which a plot filter is available. Axis supports most of the options of the UNIX graph program, but also contains many additional features.

Axis was intended to be easy to use for simple plots. It should be possible to produce a simple plot using no options or only a few options. For a finished plot, with nice labels etc., many options may be necessary.

In the simplest case, the input to axis is a series of lines, each line containing a pair of values. For example:

```
1.0  1.0
2.0  2.1
3.0  2.9
```

With this input, axis will produce a graph with a line connecting all the points. The ranges of the x and y coordinates will be chosen automatically to include all of the data.

There are a large number of options which modify the behavior of axis. These options may be specified either in the command line of axis, or in lines in the input beginning with the '#' character. For example, to set the x range to be 0 to 1.5, you can use

```
axis -x 0 1.5 < data > output
```

The minus sign on the x is optional, but it is a convention for UNIX arguments. You can also include a line in the data file:

```
# x 0 1.5
```

```
0.0 1.0
1.0 2.0
2.0 3.0
```

(the points outside the range are ignored.) There may be any number of option lines within the data file, and they may appear at any point. For most options, such as the x or y ranges, it only makes sense to specify the option once. If you specify it more than once the last specification wins. Specifications in the command line win over specifications inside the file. There are a number of options such as line style, plotting symbol, or whether the data has error bars, which can be changed in mid plot. Simply put an options line in the data file at the appropriate point. For these options, the command line option gives the initial setting.

Axis can place a title on the graph, labels on the x and y axes, labels at arbitrary points, or any character as a plotting symbol. The character set used in all of these labels is from the SLAC Unified Graphics System. It contains all the usual ASCII characters, Greek Letters, Math symbols, and some special plotting characters. The non ASCII characters are specified by troff-like escape sequences. See below.

Axis is a descendant of the UNIX graph command. Many of the options are compatible with graph, although axis does require that successive data points be on separate lines. The output of axis is in UNIX device independent graphics format (see plot(5)). To display the results use the plot filters (plot(1)).

The remainder of this document contains information on the various options to axis. They are divided into options affecting the data and how it is plotted and options affecting the labeling. The distinction is not clear. Appendix A displays the UGS character set, appendix B summarizes the escape sequences for special characters, and appendix C summarizes the options.

2 Options affecting the data plotting

2.1 x and y ranges, logarithmic scales

An “x” or a “y” in the options string, followed by two numbers, forces the x or y range to that given by the two numbers. An “x l” or a “y l” makes the corresponding axis logarithmic, and if it is followed by two numbers they are the range. An optional third number following the x or y is the distance between major tick marks along the axis. For example

```
x 0 2
x l
x l 1 1000
```

are all legal options.

2.2 Automatic abscissas

If the “-a” option is specified the x coordinate is missing from the data. Axis will then plot points evenly spaced in x. If a single number is after the “-a”, this number will be the spacing between points, and if two numbers are present they will be the spacing and the initial value of x. The “-a0” option turns off the automatic abscissas. These options may be turned on or off in midplot, or the abscissas can be restarted at any desired value. For example, to plot two traces with spacing 2, starting at 0, use “#a 2 0”, then a list of ordinates for the first trace, “a 2 0” to reset the abscissa, then the ordinates of the second trace.

2.3 Size and location of the graph.

Axis by default makes a square graph almost filling the page. To change the size of the box use “-h number”, where the number is the fraction of the default height, and “-w number” where the number is the fraction of the default width. To move the box, use “-u number” where the number is the fraction of the box size to move up, or “-r number” to move right. (It is usually necessary to move right a little if you want to label the y axis. “-r 0.1” usually works.)

To rescale the entire graph, label sizes and all, use the “-sc number” option. This rescaling is in addition to all rescalings done by the “-w”, “-h” or any of the label sizing options. It also rescales the length of the tick marks.

2.4 Error bars

A “e” (or a “-e”) in an options string means that subsequent lines of input should contain three numbers: an x value, a y value, and an error on the y value. Axis will then plot error bars. Another possible error bar option is “exy” where there are four numbers to a point: an x value, a y value, an error in x and an error in y. There are also “e2” and “exy2” forms where the errors become pairs of numbers representing the upper and lower error bar separately. The “e” option may be changed in mid plot. To turn off the error bars and return to normal plotting, use an “e0” in an options line.

2.5 Linestyles

A “m number” in the options changes the linestyle. The recognized values of the number are 0 for no lines (i.e. a point plot), 1 for solid lines (this is the default), 2 for dotted lines, 3 for short dashes, 4 for long dashes, and 5 for dot-dashed lines. Not all output devices will make all of these line styles. This option may be changed in mid plot.

2.6 Color modes

The latest version of axis supports several options for setting the color. This version merges two different lines of development so that axis files with either of the two (previously) incompatible color commands can be used.

A “cm number” in the options changes the line color. The recognized values of the number are 0 for black (this is the default) , 1 for red , 2 for green, 3 for blue, 4 for magenta, and 5 for cyan. Not all output devices will make all of these colors. This option may be changed in mid plot.

A “pencolor Color” in the options also changes the line color. In this case, “Color” is one of about 670 colors defined in colors.h. Capitalization of the color name should not matter.

Finally, the option “pencolor rgb(red,green,blue)” where red, green and blue are three integers between 0 and 65535 can be used to select a color in the rgb color model.

2.7 Labeling points and breaking lines

If the data in an input line is followed by a string in double quotes, that string is used as a label for the point. As noted before, the character set contains a selection of plotting symbols which can be used to plot the points. To set a default label for each point use the option ‘c “label”’, and to turn a default label off use “c0”. The label size can be adjusted by the option “cs number”. The default size is 1.5, in units of a terminal’s standard character size. The label size option can be changed in midplot, so you can have many different sizes of symbols in a graph. See the section 3 below on labels for instructions on the use of the special characters. This option is especially useful for plotting symbols, using the plot symbols in the character set (cross, burst, etc.).

Any options line causes a break in the data. That is, the point preceding the options line will not be connected to the following point. Thus an options line consisting only of a “#” will cause a break. The default action of axis is also to break the graph after each labeled point or error bar, that is, not to connect it to the next point. To force connections, use the option “-lb0”. The option “-lb1” restores the default action of breaking after labels or error bars. (“-b” is an archaic form of “-lb0”.) Another way to introduce a break is to use a label consisting of a blank (still in double quotation marks!).

2.8 Transposing x and y

The “t” option transposes the x and y axes. It doesn’t work on data with error bars.

2.9 Superimposing graphs

The “-s” option prevents axis from putting a screen clear at the beginning. This allows superimposing graphs, or when combined with the h,u,w, and d options, allows more than one graph on the screen.

2.10 Grid options

Use the “-g number” option to set the grid style. 0 means no grid, 1 means a frame with tick marks, and 2 means a full grid. The default is 1. The x and y axis grid types are settable using “-gx number” and “-gy number”.

2.11 Removing numbers from grid

Sometimes you may want to display to plots right next to each other, or one above the other and they will have identical x or y ranges. In this case you might want to eliminate the numerical labels on one of the graphs. Use -nxn or -nyy to turn off the labels on the x or y axis, respectively.

3 Labels

Axis will put titles on a graph, labels on the x and y axes, and labels at arbitrary points. There are a host of options to control this. All of the labels use the same character set. Like all UNIX strings, they must be enclosed in double quotes if they are more than one word. To get a real double quote into a label, use `'\`. Special characters are given by troff like escape sequences, which are a backslash (“\”) followed by two characters. For example, to get a Greek letter use `“\gX”`, which will produce the Greek equivalent of the Roman letter X. The case of the Greek letter will be the case of X. (The g may be either case, or you can use `*X` for compatibility with troff.)

Labels may have superscripts and subscripts. To start a superscript use `“\sp”`, and to end a superscript use `“\ep”`. Use `“\sb”` and `“\eb”` to start and end a subscript.

To overstrike characters, underline characters, or fill a square root sign, use `“\mk”` (mark) and `“\rt”` (return). A “mark” remembers the current point, and a “return” returns to it. Thus to make a square root sign with an “a” in it use the square root symbol, the overbar, and the a: `“\sq\mk\rn\rt a”`

To get a real backslash into the label, use two backslashes. (“\”) The escape sequences are tabulated in appendix B.

3.1 Specifying a title

Use the `'lt “title”` option to specify a title, where “title” is a character string enclosed in double quotes. If a title is given, there are other optional options

(sorry about that) to modify it. “lts number” modifies the title size, and the default size is 2. “ltx number” and “lty number” modify the placement of the title. The default is top center of the graph, and the coordinate system used is one in which the graph area runs from 0.0 to 1.0 in both the x and y directions.

4 Labeling axes

The 'lx “string”' and 'ly “string”' options to put a label on the x or y axis respectively. The “lxs number” and “lys number” options change the sizes of these labels. The default axis label size is 1.5. To change the size of the numerals on the scales for the x any y axes, use the “ls number” option, again with a default size of 1.5. “lxx number”, “lxy number”, “lyx number”, and “lyy number” change the x and y coordinates of the x and y axis labels.

5 Labels in the graph

As noted above, a line of the form

```
x_value y_value “label”
```

puts a label at the indicated coordinates (in the data’s coordinate system), and the “-c label” option may be used to set a default label, or plotting symbol, for each point. The “cs number” option changes the label size.

B Escape sequences for special characters

Escape sequence Result (backslash omitted!)

Plotting symbols

pl	plus sign
cr	cross
di	diamond
sq	square
oc	octagon
fd	fancy diamond
fs	fancy square
fx	fancy cross
fp	fancy plus
bu	burst

Greek letters (both cases)

ga,gA	alpha
gb,gB	beta
gg,gG	gamma
gd,gD	delta
ge,gE	epsilon
gz,gZ	zeta
gy,gY	eta
gh,gH	theta
gi,gI	iota
gk,gK	kappa
gl,gL	lambda
gm,gM	mu
gn,gN	nu
gc,gC	xi
go,gO	omicron
gp,gP	pi
gr,gR	rho
gs,gS	sigma
gt,gT	tau
gu,gU	upsilon
gf,gF	phi
gx,gX	chi
gq,gQ	psi
gw,gW	omega

Special symbols

tm	times
dv	divide
+-	plus or minus
\leq	less than or equal
\geq	greater than or equal
\approx	approximately equal
\neq	not equal
pt	proportional to
is	integral sign
li	line integral
pd	partial derivative
dl	del (gradient)
sr	square root
ul	underline
rn	overbar (“run”)

hb	h bar
lb	lambda bar
de	degree
in	infinity
dg	dagger
dd	double dagger
\leftarrow	left arrow
\rightarrow	right arrow
da	down arrow
ua	up arrow
la	left angle
ra	right angle
ib	interabang
sc	section

ca	cap (intersection)
cu	cup (union)
mo	member of
nm	not a member of
ex	exists
al	for all
sb	subset
ds	direct sum (xor)
dp	direct product
sp	superset

Control characters

sp start superscript
ep end superscript
sb start subscript
eb end subscript
mk mark location
rt return to mark

C Summary of options

Square brackets indicate optional modifiers. Minus sign is unnecessary, just conventional.

-x [l] [xmin xmax] [xquant]	range of x, and logarithmic flag
-y [l] [xmin xmax] [yquant]	range of y, and logarithmic flag
-a [spacing] [initial]	automatic abscissas
-a0	end automatic abscissas
-m style	linestyle
-g style	grid style
-nxn	don't put numbers on x-axis
-nyn	don't put numbers on y-axis
-s	don't erase
-e	data with errors (see Sec. 2.4)
-e2	data with asymmetric x errors
-ey	data with y errors
-exy	data with x and y errors
-exy2	data with asymmetric x and y errors
-e0	end data with errors
-cm number	color mode
-pencolor name	use named color
-pencolor rgb(red,green,blue)	use this combination of red, green and blue
-c "string"	default plot symbol
-c0	turn off default symbol
-cs number	plot symbol size
-ls number	scale character size
-lb1	break after labels
-lb0	don't break at labels
-h number	fraction of height to use
-w number	fraction of width to use
-u number	move up
-r number	move right
-sc number	rescaling factor
-lt "string"	title
-lx "string"	x axis label
-ly "string"	y axis label
-lts number	title size
-lxs number	x label size
-lys number	y label size
-ltx number	title x coordinate
-lty number	title y coordinate
-lxx number	x label x coordinate
-lxy number	x label y coordinate
-lyx number	y label x coordinate
-lyy number	y label y coordinate