pst-plot
plotting data and functions
v.1.70

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This version of \texttt{pst-plot} uses the extended keyval handling of \texttt{pst-xkey} and has a lot of the macros which were recently in the package \texttt{pstricks-add}. This documentation describes only the new and changed stuff. For the default behaviour look into the documentation part of the base \texttt{pstricks} package. You find the documentation here: \url{http://mirrors.ctan.org/graphics/pstricks/base/doc/}.

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Part I.
Basic commands, connections and labels

1. Introduction

The plotting commands described in this part are defined in the very first version of \texttt{pst-plot.tex} and available for all new and ancient versions.

The \texttt{\psdots, \pline, \pspolygon, \pscurve, \pscurve} and \texttt{\psccurve} graphics objects let you plot data in a variety of ways. However, first you have to generate the data and enter it as coordinate pairs $x, y$. The plotting macros in this section give you other ways to get and use the data.

To parameter \texttt{plotstyle=style} determines what kind of plot you get. Valid styles are dots, line, polygon, curve, ecurve, ccurve. E.g., if the \texttt{plotstyle} is polygon, then the macro becomes a variant of the \texttt{\pspolygon} object.

You can use arrows with the plot styles that are open curves, but there is no optional argument for specifying the arrows. You have to use the \texttt{arrows} parameter instead.

No PostScript error checking is provided for the data arguments. There are system-dependent limits on the amount of data \LaTeX{} and PostScript can handle. You are much less likely to exceed the PostScript limits when you use the line, polygon or dots plot style, with \texttt{showpoints=false, linearc=0pt}, and no arrows.

Note that the lists of data generated or used by the plot commands cannot contain units. The values of \texttt{\psxunit} and \texttt{\psyunit} are used as the unit.

2. Plotting data records

\begin{align*}
\texttt{\fileplot[Options] {file}} \\
\texttt{\psfileplot[Options] {file}} \\
\texttt{\dataplot[Options] {\langle macro\rangle}} \\
\texttt{\psdataplot[Options] {\langle macro\rangle}} \\
\texttt{\savedata{\langle macro\rangle}[data]} \\
\texttt{\readdata{\langle macro\rangle}{file}} \\
\texttt{\psreadColumnData{colNo}{delimiter}{\langle macro\rangle}{filename}} \\
\texttt{\listplot{data}} \\
\texttt{\pslistplot{data}}
\end{align*}

The macros with a preceeding \texttt{ps} are equivalent to those without.

\texttt{\fileplot} is the simplest of the plotting functions to use. You just need a file that contains a list of coordinates (without units), such as generated by Mathematica or other mathematical packages. The data can be delimited by curly braces \{ }, parentheses \( \), commas, and/or white space. Bracketing all the data with square brackets [ ] will significantly speed up the rate at which the data is read, but there are system-dependent
limits on how much data \TeX can read like this in one chunk. (The \texttt{must} go at the beginning of a line.) The file should not contain anything else (not even \texttt{endinput}), except for comments marked with \%. \fileplot only recognizes the line, polygon and dots plot styles, and it ignores the arrows, \texttt{linearc} and \texttt{showpoints} parameters. The \listplot command, described below, can also plot data from file, without these restrictions and with faster \TeX processing. However, you are less likely to exceed PostScript’s memory or operand stack limits with \fileplot.

If you find that it takes \TeX a long time to process your \fileplot command, you may want to use the \PSTtoEPS command described on page ??.

\fileplot is also for plotting lists of data generated by other programs, but you first have to retrieve the data with one of the following commands: \texttt{data} or the data in \texttt{file} should conform to the rules described above for the data in \fileplot (with \texttt{savedata}, the data must be delimited by \texttt{[ ]}, and with \texttt{readdata}, bracketing the data with \texttt{[ ]} speeds things up). You can concatenate and reuse lists, as in

\begin{verbatim}
\readdata{\foo}{foo.data}
\readdata{\bar}{bar.data}
\dataplot{\foo\bar}
\dataplot{\origin={0,1}}{\bar}
\end{verbatim}

The \texttt{readdata} and \texttt{dataplot} combination is faster than \fileplot if you reuse the data. \fileplot uses less of \TeX’s memory than \readdata and \dataplot if you are also use \PSTtoEPS.

Here is a plot of $\int \sin(x)\,dx$. The data was generated by Mathematica, with

\begin{verbatim}
Table[{x,N[SinIntegral[x]]},{x,0,20}]
\end{verbatim}

and then copied to this document.

\begin{verbatim}
\pspicture(4,3) \psset{xunit=.2cm,yunit=1.5cm}
\savedata{\mydata}{

{{0, 0}, {1., 0.946083}, {2., 1.60541}, {3., 1.84865}, {4., 1.7582},
 {5., 1.54993}, {6., 1.42469}, {7., 1.4546}, {8., 1.57419},
 {9., 1.66504}, {10., 1.65835}, {11., 1.57831}, {12., 1.50497},
 {13., 1.49936}, {14., 1.55621}, {15., 1.61819}, {16., 1.6313},
 {17., 1.59014}, {18., 1.53661}, {19., 1.51863}, {20., 1.54824}}
\dataplot{\plotstyle=curve,\showpoints,\dotstyle=triangle}{\mydata}
\psline{<->}(0,2)(0,0)(22,0)
\end{pspicture}
\end{verbatim}

\listplot is yet another way of plotting lists of data. This time, \texttt{<list>} should be a list of data (coordinate pairs), delimited only by white space. \texttt{list} is first expanded by
TEX and then by PostScript. This means that list might be a PostScript program that leaves on the stack a list of data, but you can also include data that has been retrieved with \readdata and \dataplot. However, when using the line, polygon or dots plot-styles with showpoints=false, linearc=0pt and no arrows, \dataplot is much less likely than \listplot to exceed PostScript’s memory or stack limits. In the preceding example, these restrictions were not satisfied, and so the example is equivalent to when \listplot is used:

\listplot[plotstyle=curve,showpoints=true,dotstyle=triangle]{mydata}

3. Plotting mathematical functions

$\psplot[Options]{x_1 \text{ min} @}{x_1 \text{ max} @}{\text{function}}$

$\text{parametricplot}[Options]{t_1 \text{ min} @}{t_1 \text{ max} @}{x(t)\ y(t)}$

$\psplot$ can be used to plot a function $f(x)$, if you know a little PostScript. function should be the PostScript or algebraic code for calculating $f(x)$. Note that you must use $x$ as the dependent variable.

$\psplot[plotpoints=200]{0}{720}{x\ \text{sin}}$

plots sin($x$) from 0 to 720 degrees, by calculating sin($x$) roughly every 3.6 degrees and then connecting the points with $\psline$. Here are plots of $\sin(x)\ \cos((x/2)^2)$ and $\sin^2(x)$:

$\pspicture(0,-1)(4,1)$
$\psset{xunit=1.2 pt}$
$\psplot[linecolor=gray,linewidth=1.5 pt,plotstyle=curve]{0}{90}{x\ \text{sin} \ \text{dup} \ \text{mul}}$
$\psplot[plotpoints=100]{0}{90}{x\ \text{sin} \ \text{x} \ \text{2} \ \text{div} \ \text{2} \ \text{exp} \ \text{cos} \ \text{mul}}$
$\psline{<->}(0,-1)(0,1) \psline{->}(100,0)$
$\endpspicture$

$\text{parametricplot}$ is for a parametric plot of $(x(t), y(t))$. function is the PostScript code or algebraic expression for calculating the pair $x(t)\ y(t)$.

For example,

$\pspicture(3,3)$
$\text{parametricplot}[plotstyle=dots,plotpoints=13]\%
\{-6\}{6}\{1.2 \ \text{t} \ \text{exp} \ 1.2 \ \text{t} \ \text{neg} \ \text{exp}}$
$\endpspicture$
plots 13 points from the hyperbola $xy = 1$, starting with $(1.2^{-6}, 1.2^6)$ and ending with $(1.2^6, 1.2^{-6})$.

Here is a parametric plot of $(\sin(t), \sin(2t))$:

\begin{pspicture}(-2,-1)(2,1)
\psset{xunit=1.7cm}
\parametricplot[linewidth=1pt,plotstyle=curve]{0}{360}{t sin t 2 mul sin}
\psline{<->}(0,-1.2)(0,1.2)
\psline{<->}(-1.2,0)(1.2,0)
\endpspicture

The number of points that the \psplot and \psparametricplot commands calculate is set by the plotpoints=<value> parameter. Using "curve" or its variants instead of "line" and increasing the value of plotpoints are two ways to get a smoother curve. Both ways increase the imaging time. Which is better depends on the complexity of the computation. (Note that all PostScript lines are ultimately rendered as a series (perhaps short) line segments.) Mathematica generally uses "lineto" to connect the points in its plots. The default minimum number of plot points for Mathematica is 25, but unlike \psplot and \psparametricplot, Mathematica increases the sampling frequency on sections of the curve with greater fluctuation.

\section*{Part II.
New commands}

4. Extended syntax for \psplot, \psparametricplot, and \psaxes

There is now a new optional argument for \psplot and \psparametricplot to pass additional PostScript commands into the code. This makes the use of \texttt{\pstVerb} in most cases superfluous.

\begin{pspicture}(-1,-0.5)(12,5)
\psaxes[Dx=100,dx=1,Dy=0.00075,dy=1]{{->}}(0,0)(12,5)[x$,90][y$,180]
\psplot{0}{11}{/const1 3.3 10 8 neg exp mul def}
\end{pspicture}
\s 10 def
/const2 6.04 10 6 neg exp mul def ] % optional PS commands
{ const1 x 100 mul dup mul mul Euler const2 neg x 100 mul dup mul mul exp
mul 2000 mul}
\end{pspicture}
5. New Macro \texttt{psBoxplot}

A box-and-whisker plot (often called simply a box plot) is a histogram-like method of displaying data, invented by John Tukey. The box-and-whisker plot is a box with ends at the quartiles $Q_1$ and $Q_3$ and has a statistical median $M$ as a horizontal line in the box. The “whiskers” are lines to the farthest points that are not outliers (i.e., that are within $3/2$ times the interquartile range of $Q_1$ and $Q_3$). Then, for every point more than $3/2$ times the interquartile range from the end of a box, is a dot.

The only special optional arguments, beside all other which are valid for drawing lines and filling areas, are \texttt{IQLfactor}, \texttt{barwidth}, and \texttt{arrowlength}, where the latter is a factor which is multiplied with the barwidth for the line ends. The \texttt{IQLfactor}, preset to 1.5, defines the area for the outliners. The outliners are plotted as a dot and take the settings for such a dot into account, eg. \texttt{dotstyle}, \texttt{dotsize}, \texttt{dotscale}, and \texttt{fillcolor}. The default is the black dot.

\begin{pspicture}(-1,-1)(12,14)
The next example uses an external file for the data, which must first be read by the macro \texttt{\readdata}. The next one creates a horizontal boxplot by rotating the output with $-90$ degrees.
It is also possible to read a data column from an external file:

\begin{filecontents}{Data.dat}
98, 32
20, 11
79, 26
14, 9
23, 22
21, 10
58, 25
13, 8
19, 5
53, 29
41, 37
11, 2
83, 25
71, 51
10, 7
89, 17
10, 6
, 41
, 75
\end{filecontents}
With the optional argument postAction one can modify the \( y \) value of the boxplot, e.g. for an output with a vertical axis in logarithm scaling:
It uses the PostScript function \( \text{Log} \) instead of \( \text{log} \). The latter cannot handle zero values. The next examples shows how a very small intervall can be handled:
6. The psgraph environment

This new environment psgraph does the scaling, it expects as parameter the values (without units!) for the coordinate system and the values of the physical width and height (with units!). The syntax is:

\begin{psgraph} [Options] {<arrows>} %
  (xOrig,yOrig) (xMin,yMin) (xMax,yMax) {xLength} {yLength}
  ...
\end{psgraph}

\begin{psgraph} [Options] {<arrows>} %
  (xOrig,yOrig) (xMin,yMin) (xMax,yMax) {xLength} {yLength}
  ...
\end{psgraph}

where the options are valid only for the \texttt{\psaxes} macro. The first two arguments have the usual PSTricks behaviour:

- if \((x\text{Orig},y\text{Orig})\) is missing, it is substituted to \((x\text{Min},x\text{Max});\)
- if \((x\text{Orig},y\text{Orig})\) and \((x\text{Min},y\text{Min})\) are missing, they are both substituted to \((0,0)\).

The y-length maybe given as \(!;\) then the macro uses the same unit as for the x-axis.

\begin{verbatim}
\readdata{\data}{demol.data}
\pstScalePoints{1,1e-08}{} \% (x,y){additional x operator}{y op}
\psset{llx=-1cm, lly=-1cm}
\begin{psgraph}[axesstyle=frame, xticksize=0 7.59, yticksize=0 25, %
  subticks=0, ylabelFactor=\cdot 10^8, %
  Dy=1,psyunit, Dy=1]{0,0}(25,7.5){10cm}{6cm} \% parameters
\listplot[linecolor=red, linewidth=2pt, showpoints=true]{\data}
\end{psgraph}
\end{verbatim}

In the following example, the y unit gets the same value as the one for the x-axis.
6. The psgraph environment

\psset{llx=-1cm,lly=-0.5cm,ury=0.5cm}
\begin{psgraph}(0,0)(5,3){6cm}{!} % x-y-axis with same unit
  \psplot[linecolor=red,linewidth=1pt](0){5}{x dup mul 10 div}
\end{psgraph}

\readdata\{data\}{demo1.data}
\psset{xAxisLabel=x-Axis,yAxisLabel=y-Axis,llx=-.5cm,lly=-1cm,ury=0.5cm, xAxisLabelPos={c,-1},yAxisLabelPos={-7,c}}
\pstScalePoints(1,0.00000001){}{},{}
\begin{psgraph}[axesstyle=frame,xticksize=0 7.5,yticksize=0 25,subticksize=1, ylabelFactor=\cdot 10^8,Dx=5,Dy=1,xsubticks=2](0,0)(25,7.5){5.5cm}{5cm}
  \listplot[linecolor=red,linewidth=2pt,showpoints=true]{data}
\end{psgraph}
\readdata{\data}{demol.data}
\psset{llx=-0.5cm,lly=-1cm}
\pstScalePoints(1,0.000001){{}}
\psgraph[arrows=->,Dx=5,dy=200\psunit,Dy=200,subticks=5,ticksize=-10pt 0,
tickwidth=0.5pt,subtickwidth=0.1pt](0,0)(25,750){5.5cm}{5cm}
\listplot[linecolor=red,linewidth=0.5pt,showpoints=true,dotscale=3,
plotstyle=LineToYAxis,dotstyle=o]{\data}
\endpsgraph

\readdata{\data}{demol.data}
\psgraph[ylogBase=10,Dx=5,Dy=1,subticks=5](0,0)(25,2){12cm}{4cm}
\listplot[linecolor=red,linewidth=1pt,showpoints,dotstyle=x,dotscale=2]{\data}
\endpsgraph
\begin{psgraph}[arrows=->,Dx=0.5,ylogBase=10,Oy=-1,xsubticks=10,\% 
ysubticks=2](0,-3)(3,1){12cm}{4cm} 
\psset{Oy=-2}\% must be global 
\listplot[linecolor=red,linewidth=1pt,showpoints=true,plotstyle=LineToXAxis]{\data} 
\listplot[plotstyle=values,rot=90]{\data} \end{psgraph}
\textbf{6. The psgraph environment}

\begin{verbatim}
\readdata{data}{demo2.data}
\readdata{dataII}{demo3.data}
\pstScalePoints(1,1){1989 sub}
\psset{llx=-0.5cm,lly=-1cm, xAxisLabel=Year,yAxisLabel=Whatever,%
  xAxisLabelPos={c,-0.4in},yAxisLabelPos={-0.4in,c}}
\psgraph[axesstyle=frame, Dx=2, Ox=1989, subticks=2](0,0)(12,6){4in}{2in}%
\listplot[linecolor=red,linewidth=2pt]{data}
\listplot[linecolor=blue,linewidth=2pt]{dataII}
\listplot[linecolor=cyan,linewidth=2pt,yunit=0.5]{dataII}
\endpsgraph
\end{verbatim}
An example with ticks on every side of the frame and filled areas:

\begin{psgraph}[axesstyle=frame,Dx=2,0x=1989,0y=2,subticks=2](0,0)(12,4)(6in){3in}
\listplot[linecolor=red,linewidth=12pt]{data}
\listplot[linecolor=blue,linewidth=12pt]{dataII}
\listplot[linecolor=cyan,linewidth=12pt,yunit=0.5]{dataII}
\end{psgraph}

\def\data{0 0 1 4 1.5 1.75 2.25 4 2.75 7 3 9}
\psset{ll=y=-0.5cm}
\begin{psgraph}[axesstyle=none,ticks=none](0,0)(3,9){12cm}{5cm}
\pscustom[fillstyle=solid,fillcolor=red!40,linestyle=none]{% 
\listplot[\data]
\psline(3,9)(3,0)}
\pscustom[fillstyle=solid,fillcolor=blue!40,linestyle=none]{% 
\listplot[\data]
\psline(3,9)(0,9)}
\listplot[linewidth=2pt]{\data}
\psaxes[axesstyle=frame,ticksize=0pt,subticks=20,ysubticks=4,tickstyle=inner,dy=2,Dy=2,tickwidth=1.5pt,subtickcolor=black](0,0)(3,9)
\rput*(2.5,3){level 1}\rput*(1,7){level 2}
\end{psgraph}
6.1. Coordinates of the psgraph area

The coordinates of the calculated area are saved in the four macros \psgraphLLx, \psgraphLLy, \psgraphURx, and \psgraphURy, which is LowerLeft, UpperLeft, LowerRight, and UpperRight. The values have no dimension but are saved in the current unit.

\begin{psgraph}[axesstyle=none,ticks=none](0,0)(3.0,9.0){4cm}{5cm}
\end{psgraph}

6.2. The new options for psgraph

<table>
<thead>
<tr>
<th>name</th>
<th>default</th>
<th>meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>xAxisLabel</td>
<td>x</td>
<td>label for the x-axis</td>
</tr>
<tr>
<td>yAxisLabel</td>
<td>y</td>
<td>label for the y-axis</td>
</tr>
<tr>
<td>xAxisLabelPos</td>
<td>{}</td>
<td>where to put the x-label</td>
</tr>
<tr>
<td>yAxisLabelPos</td>
<td>{}</td>
<td>where to put the y-label</td>
</tr>
<tr>
<td>xlabelsep</td>
<td>5pt</td>
<td>labelsep for the x-axis labels</td>
</tr>
<tr>
<td>ylabelsep</td>
<td>5pt</td>
<td>labelsep for the y-axis labels</td>
</tr>
<tr>
<td>llx</td>
<td>0pt</td>
<td>trim for the lower left x</td>
</tr>
<tr>
<td>lly</td>
<td>0pt</td>
<td>trim for the lower left y</td>
</tr>
<tr>
<td>urx</td>
<td>0pt</td>
<td>trim for the upper right x</td>
</tr>
<tr>
<td>ury</td>
<td>0pt</td>
<td>trim for the upper right y</td>
</tr>
<tr>
<td>axespos</td>
<td>bottom</td>
<td>draw axes first (bottom or last (top)</td>
</tr>
</tbody>
</table>

There is one restriction in using the trim parameters, they must be set before \psgraph is called. They are redundant when used as parameters of \psgraph itself. The xAxisLabelPos and yAxisLabelPos options can use the letter c for centering an x-axis or y-axis label. The c is a replacement for the x or y value. When using values with units, the position is always measured from the origin of the coordinate system, which can be outside of the visible pspicture environment.
6.3. The new macro \pslegend for \psgraph

\readdata{data}{demo2.data}
\readdata{dataII}{demo3.data}
\psset{llx=-1cm,lly=-1.25cm,urx=0.5cm,ury=0.1in,xAxisLabel=Year,%
yAxisLabel=Whatever,xAxisLabelPos={c,-0.4in},%
yAxisLabelPos={-0.4in,c}}
\pstScalePoints(1,1){1989 sub}{}
\psframebox{linestyle=dashed,boxsep=false}{%
\begin{psgraph}[axesstyle=frame,OX=1989,subticks=2](0,0)(12,6){0.8\linewidth}{2.5in}
\listplot[linecolor=red,linewidth=2pt]{data}%
\listplot[linecolor=blue,linewidth=2pt]{dataII}%
\listplot[linecolor=cyan,linewidth=2pt,yunit=0.5]{dataII}%
\end{psgraph}%}

6.3. The new macro \pslegend for \psgraph

\pslegend [Reference] (xOffset,yOffset) {Text}

The reference can be one of the lb, lt, rb, or rt, where the latter is the default. The values for xOffset and yOffset must be multiples of the unit pt. Without an offset the value of \pslabelsep are used. The legend has to be defined before the environment psgraph.
6.3. The new macro \pslegend for \psgraph

\begin{verbatim}
\readdata{\data}{demo2.data}
\readdata{\dataII}{demo3.data}
\psset{llx=-1cm,lly=-1.25cm,urx=0.5cm,ury=0.1in,xAxisLabel=Year, %
yAxisLabel=Whatever,xAxisLabelPos={c,-0.4in},%
yAxisLabelPos={-0.4in,c}}
\pstScalePoints(1,1){1989 sub}{%}
\pslegend[lt]{\red\rule[1ex]{2em}{1pt} & Data I \%
\blue\rule[1ex]{2em}{1pt} & Data II \%
\cyan\rule[1ex]{2em}{1pt} & Data III}
\begin{psgraph}[axesstyle=frame,0x=1989,subticks=2](0,0)(12,6){0.8\linewidth}{2.5in}%
\listplot[linecolor=red,linewidth=2pt]{\data}\%
\listplot[linecolor=blue,linewidth=2pt]{\dataII}\%
\listplot[linecolor=cyan,linewidth=2pt,yunit=0.5]{\dataII}\%
\end{psgraph}%
\end{verbatim}

- \pslegend uses the commands \tabular and \endtabular, which are only available when running \LaTeX. With \TeX you have to redefine the macro \pslegend@ii:

\begin{verbatim}
def\pslegend@ii[#1]{\rput[#1]{\psframebox[style=legendstyle]{%\footnotesize\tabcolsep=2pt\%\tabular[t]{@{}ll@{}}}\pslegend@text\endtabular}}\gdef\pslegend@text{}}
\end{verbatim}

- The fontsize can be changed locally for each cell or globally, when also redefining the macro \pslegend@ii.
- If you want to use more than two columns for the table or a shadow box, then redefine \pslegend@ii.

The macro \psframebox uses the style \texttt{legendstyle} which is preset to fillstyle=solid, fillcolor=white, and linewidth=0.5pt and can be redefined by

\begin{verbatim}
\newpsstyle{legendstyle}{fillstyle=solid,fillcolor=red!20,shadow=true}
\end{verbatim}
6.3. The new macro `\pslegend` for `psgraph`

\begin{verbatim}
\readdata{\data}{demo2.data}\
\readdata{\dataII}{demo3.data}\
\psset{llx=-1cm,lly=-1.25cm,urx=0.5cm,ury=0.1in,xAxisLabel=Year,\%
  yAxisLabel=Whatever,xAxisLabelPos={c,-0.4in},\%
  yAxisLabelPos={-0.4in,c}}\
\pstScalePoints(1,1){1989 \sub}\{}\
\newpsstyle{legendstyle}{fillstyle=solid,fillcolor=red!20,shadow=true}\
\pslegend[lt](10,10){\red\rule[1ex]{2em}{1pt} & Data I\%
  \blue\rule[1ex]{2em}{1pt} & Data II\%
  \cyan\rule[1ex]{2em}{1pt} & Data III}\
\begin{psgraph}[axesstyle=frame,OX=1989,subticks=2](0,0)(12,6){0.8\linewidth}{2.5in}%
  \listplot[linecolor=red,linewidth=2pt]{\data}%
  \listplot[linecolor=blue,linewidth=2pt]{\dataII}%
  \listplot[linecolor=cyan,linewidth=2pt,\yunit=0.5]{\dataII}\
\end{psgraph}%
\end{verbatim}
7. \texttt{\psxTick} and \texttt{\psyTick}

Single ticks with labels on an axis can be set with the two macros \texttt{\psxTick} and \texttt{\psyTick}. The label is set with the macro \texttt{\pshlabel}, the setting of \texttt{mathLabel} is taken into account.

\begin{verbatim}
\psxTick [Options] {rotation} (x value){label}
\psyTick [Options] {rotation} (y value){label}
\end{verbatim}

8. \texttt{\pstScalePoints}

The syntax is

\begin{verbatim}
\pstScalePoints(xScale,xScale){xPS}{yPS}
\end{verbatim}

\texttt{xScale,yScale} are decimal values used as scaling factors, the \texttt{xPS} and \texttt{yPS} are additional PostScript code applied to the x- and y-values of the data records. This macro is only valid for the \texttt{\listplot} macro!

\begin{verbatim}
\def\data{%
  0 0 1 3 2 4 3 1
  4 2 5 3 6 6 }
\begin{pspicture}(-0.5,-1)(6,6)
\psaxes->{->}(0,0)(6,6)
\listplot[showpoints=true,\texttt{\linecolor=red}]\{\data\}
\pstScalePoints(1,0.5){}{3 \texttt{add}}
\listplot[showpoints=true,\texttt{\linecolor=blue}]\{\data\}
\end{pspicture}
\end{verbatim}

\texttt{\pstScalePoints(1,0.5){}{3 \texttt{add}}} means that \textbf{first} the value 3 is added to the \textit{y} values and \textbf{second} this value is scaled with the factor 0.5. As seen for the blue line for \textit{x} = 0 we get \textit{y}(0) = (0 + 3) \cdot 0.5 = 1.5.

Changes with \texttt{\pstScalePoints} are always global to all following \texttt{\listplot} macros. This is the reason why it is a good idea to reset the values at the end of the \texttt{pspicture} environment.
9. New or extended options

9.1. Introduction

The option tickstyle=full |top|bottom no longer works in the usual way. Only the additional value inner is valid for \texttt{pst-plot}, because everything can be set by the \texttt{ticksize} option. When using the comma or trigLabels option, the macros \texttt{\psxlabel} and \texttt{\psylabel} shouldn’t be redefined, because the package does it itself internally in these cases. However, if you need a redefinition, then do it for \texttt{\pst@@@hlabel} and \texttt{\pst@@@vlabel} with

\begin{verbatim}
\makeatletter
\def\pst@@@hlabel#1{...}
\def\pst@@@vlabel#1{...}
\makeatother
\end{verbatim}

\begin{table}[h]
\begin{tabular}{|l|l|l|l|}
\hline
name       & type                        & default & page \\
\hline
axesstyle  & none|axes|frame|polar|inner & axes & 32 \\
barwidth   & length                      & 0.25cm & 74 \\
ChangeOrder& boolean                     & false  & 72 \\
comma      & boolean                     & false  & 38 \\
decimals   & integer                     & -1\textsuperscript{1} & 80 \\
decimalSeparator& char                       & .     & 38 \\
fontscale  & real                        & 10     & 80 \\
ignoreLines& integer                     & 0      & 64 \\
labelFontSize& macro                     & {}    & 36 \\
labels     & all|x|y|none                 & all    & 34 \\
llx        & length                      & 0pt    & 21 \\
llly       & length                      & 0pt    & 21 \\
logLines   & none|x|y|all                 & none   & 52 \\
mathLabel  & boolean                     & false  & 36 \\
nEnd       & integer or empty            & {}     & 68 \\
nStart     & integer                     & 0      & 67 \\
nStep      & integer                     & 1      & 65 \\
plotNo     & integer                     & 1      & 69 \\
plotNoMax  & integer                     & 1      & 69 \\
plotstyle  & style                       & line   & 29 \\
polarplot  & boolean                     & false  & 82 \\
PSfont     & PS font                     & Times-Romasn & 80 \\
psgrid     & boolean                     & false  & 63 \\
\hline
\end{tabular}
\caption{All new parameters for \texttt{pst-plot}}
\end{table}

\textsuperscript{1} A negative value plots all decimals
... continued

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</tbody>
</table>
9.2. Option plotstyle (Christoph Bersch)

There is a new value cspline for the plotstyle to interpolate a curve with cubic splines.

\readdata{\foo}{data1.dat}
\begin{psgraph}[axesstyle=frame,ticksize=6pt,subticks=5,ury=1cm,
    Ox=250, Dx=10, Oy=-2,](250,-2)(310,0.2){0.8\linewidth}{0.3\linewidth}
\end{psgraph}

\listplot[plotstyle=cspline,linecolor=red,linewidth=0.5pt,showpoints]{\foo}

9.3. Option xLabels, yLabels, xLabelsrot, and yLabelsrot

\psset{xunit=0.75}
\begin{pspicture}(-2,-2)(14,4)
\psaxes[xLabels=\{Kerry,Laois,London,Waterford,Clare,Offaly,\%
    Galway,Wexford,Dublin,Limerick,Tipperary,Cork,Kilkenny\},xLabelsRot=45,
    yLabels=\{low,medium,high\},mathLabel=false](14,4)
\end{pspicture}

The values for xlabelsep and ylabelsep are taken into account.
9.4. Option xLabelOffset and ylabelOffset

```
\psset{xAxisLabel=,yAxisLabel=, llx=-5mm,urx=1cm,lly=-5mm, mathLabel=false,xlabelsep=-5pt, xLabels={A,b,C,d,E,f}}
\begin{psgraph}{->}(5,2){6cm}{2cm}
\end{psgraph}
```

9.5. Option yMaxValue and yMinValue

With the new optional arguments yMaxValue and yMinValue one can control the behaviour of discontinuous functions, like the tangent function. The code does not check that yMaxValue is bigger than yMinValue (if not, the function is not plotted at all). All four possibilities can be used, i.e. one, both or none of the two arguments yMaxValue and yMinValue can be set.

```
\begin{pspicture}(-6.5,-6)(6.5,7.5)
\multido{\rA=-4.71239+\psPiH}{7}{%
 \psline[linecolor=black!20,linestyle=dashed](\rA,-5.5)(\rA,6.5)}
\psset{algebraic,plotpoints=10000,plotstyle=line}
\psaxes[trigLabelBase=2,dx=\psPiH,xunit=\psPi,trigLabels]{-}(0,0)(-1.7,-5.5)(1.77,6.5)[x,0][y,-90]
\psclip{\psframe[linestyle=none](-4.55,-5.5)(5.55,6.5)}
\psplot[yMaxValue=6,yMinValue=-5,linewidth=2pt,linestyle=dashed,linestyle=dashed]{{-4.8}}{4.8}{\times}
\rput(0,0.5){$\times$}
\endpsclip
\psplot[yMinValue=-5,linewidth=2pt,linestyle=dashed,linestyle=dashed]{{-4.8}}{4.8}{\times}
\rput(0,0.5){$\times$}
\end{pspicture}
```
9.6. Option axesstyle

There is a new axes style `polar` which plots a polar coordinate system.

**Syntax:**

```
\psplot[axesstyle=polar](Rx,Angle)
\psplot[axesstyle=polar](...)(Rx,Angle)
\psplot[axesstyle=polar](...)(...)(Rx,Angle)
```

Important is the fact, that only one pair of coordinates is taken into account for the radius and the angle. It is *always* the last pair in a sequence of allowed coordinates for the `psaxes` macro. The other ones are ignored; they are not valid for the polar coordinate system. However, if the angle is set to 0 it is changed to 360 degrees for a full circle.
All valid optional arguments for the axes are also possible for the polar style, if they make sense ... :-) Important are the Dy option, it defines the angle interval and subticks, for the intermediate circles and lines. The number can be different for the circles (ysubticks) and the lines (xsubticks).

\begin{pspicture}(-3,-3.5)(3.5,3.5)
\psaxes[axesstyle=polar]
\psplot[polarplot,algebraic,linecolor=red,linewidth=2pt,plotpoints=2000\{0\}{\TwoPi\{0\}\{\TwoPi\}}]{0\{\TwoPi\}2*\sin(x)-x)/\cos(x)+x}}
\end{pspicture}
\begin{pspicture}(-3.5,-3.5)(3.5,3.5)
\psaxes[axesstyle=polar,subticklinestyle=dashed,subticks=2,\xlabelFontSize=\scriptstyle]
\psplot[polarplot,algebraic,linecolor=red,linewidth=2pt,plotpoints=2000\{0\}\{\TwoPi\}6*\sin(x)+\cos(x)}
\end{pspicture}
9.7. Option \texttt{xyAxes, xAxis and yAxis}

Syntax:

\begin{verbatim}
xyAxes=true|false
xAxis=true|false
yAxis=true|false
\end{verbatim}

Sometimes there is only a need for one axis with ticks. In this case you can set one of the preceding options to false. The \texttt{xyAxes} only makes sense when you want to set both \texttt{x} and \texttt{y} to true with only one command, back to the default, because with \texttt{xyAxes=false} you get nothing with the \texttt{psaxes} macro.

As seen in the example, a single \texttt{y} axis gets the labels on the left side. This can be changed with the option \texttt{ylabelPos} or with \texttt{xlabelPos} for the \texttt{x}-axis.

9.8. Option \texttt{labels}

Syntax:
9.9. Options xlabelPos and ylabelPos

Syntax:

\begin{verbatim}
xlabelPos=bottom|axis|top
ylabelPos=left|axis|right
\end{verbatim}

By default the labels for ticks are placed at the bottom (x axis) and left (y-axis). If both axes are drawn in the negative direction the default is top (x axis) and right (y axis). It be changed with the two options xlabelPos and ylabelPos. With the value axis the user can place the labels depending on the value of labelsep, which is taken into account for axis.
This option sets the horizontal and vertical font size for the labels depending on the option mathLabel (xmathLabel/ymathLabel) for the text or the math mode. It will be overwritten when another package or a user defines

\begin{pspicture}(-1,1)(3,-3)
\psaxes[xlabelPos=top,
xticksize=0 20pt,
yticksize=-20pt 0]{->}(3,-3)
\end{pspicture}

\begin{pspicture}(3,3)
\psaxes[-](3,3)
\end{pspicture}

\begin{pspicture}(-3,-3)
\psaxes[-](3,3)
\end{pspicture}

\begin{pspicture}(-3,-3)
\psaxes[-](3,3)
\end{pspicture}

\begin{pspicture}(3,-3)
\psaxes[-](3,3)
\end{pspicture}

\begin{pspicture}(3,-3)
\psaxes[-](3,3)
\end{pspicture}

\begin{pspicture}(-3,-3)
\psaxes[-](3,3)
\end{pspicture}

\begin{pspicture}(3,-3)
\psaxes[-](3,3)
\end{pspicture}

\begin{pspicture}(-3,-3)
\psaxes[-](3,3)
\end{pspicture}

\begin{pspicture}(-3,-3)
\psaxes[-](3,3)
\end{pspicture}

9.10. Options xlabelFontSize and ymathLabel

This option sets the horizontal and vertical font size for the labels depending on the option mathLabel (xmathLabel/ymathLabel) for the text or the math mode. It will be overwritten when another package or a user defines

\def\psxlabel#1{\xlabelFontSize ...
\def\psylabel#1{\ylabelFontSize ...
\def\psxlabel#1{\xlabelFontSize ...
\def\psylabel#1{\ylabelFontSize ...
\def\psxlabel#1{\xlabelFontSize ...
\def\psylabel#1{\ylabelFontSize ...
\def\psxlabel#1{\xlabelFontSize ...
\def\psylabel#1{\ylabelFontSize ...

in another way. Note that for mathLabel=true the font size must be set by one of the mathematical styles \textstyle, \displaystyle, \scriptstyle, or \scriptscriptstyle.
9.11. Options xlabelFactor and ylabelFactor

When having big numbers as data records then it makes sense to write the values as $<\text{number}> \cdot 10^{<\text{exp}>}$. These new options allow you to define the additional part of the value, but it must be set in math mode when using math operators or macros like $\cdot$!
9.12. Options \texttt{decimalSeparator} and comma

Syntax:

\begin{verbatim}
comma=false|true  
decimalSeparator=<character>
\end{verbatim}

Setting the option \texttt{comma} to true gives labels with a comma as a decimal separator instead of the default dot. \texttt{comma} and \texttt{comma=true} is the same. The optional argument \texttt{decimalSeparator} allows an individual setting for languages with a different character than a dot or a comma. The character has to be set into braces, if it is an active one, e.g. \texttt{decimalSeparator={.}}.
9.13. Options xyDecimals, xDecimals and yDecimals

Syntax:

\begin{verbatim}
xyDecimals=<number>
xDecimals=<any>
yDecimals=<any>
\end{verbatim}

By default the labels of the axes get numbers with or without decimals, depending on
the numbers itself. With these options it is possible to determine the decimals, where
the option xyDecimals sets this identical for both axes. xDecimals only for the $x$ and
yDecimals only for the $y$ axis. The default setting {} means, that you’ll get the standard
behaviour.

\begin{pspicture}(-1.5,-0.5)(5,3.75)
\psaxes[xyDecimals=2]{->}(0,0)(4.5,3.5)
\end{pspicture}

\begin{pspicture}(-0.1,-150)(1.5,550.0)
\psaxes[Dx=0.25,Dy=100,ticksize=-4pt 0,comma,xDecimals=3,yDecimals=1]{->}%
(0,0)(0,-100)(1.4,520)[\textbf{Ampère},-90][\textbf{Voltage},0]
\end{pspicture}

With the option trigLabels=true only the labels on the $x$ axis are trigonometrical ones. It is the same than setting xtrigLabels=true. The option trigLabelBase sets the denominator of fraction. The default value of 0 is the same as no fraction. The following constants are defined in the package:

```
def\psPiFour{12.566371}
def\psPiTwo{6.283185}
def\psPi{3.14159265}
def\psPiH{1.570796327}
newdimen\pstRadUnit
\newdimen\pstRadUnitInv
\pstRadUnit=1.047198cm \text{ % this is } \pi/3
\pstRadUnitInv=0.95493cm \text{ % this is } 3/\pi
```

Because it is a bit complicated to set the right values, we show some more examples here. For all following examples in this section we did a global

```
\psset{trigLabels,labelFontSize=\scriptstyle}
```

Translating the decimal ticks to trigonometrical ones makes no real sense, because every 1 xunit (1cm) is a tick and the last one is at 6cm.
Modifying the ticks to have the last one exactly at the end is possible with a different \( dx \) value (\( \frac{\pi}{3} \approx 1.047 \)):

Set everything globally in radian units. Now 6 units on the \( x \)-axis are \( 6\pi \). Using \( \text{trigLabelBase}=3 \) reduces this value to \( 2\pi \), a.s.o.
The best way seems to be to set the $x$-unit to \texttt{\textbackslash pstRadUnit}. Plotting a function doesn’t consider the value for \texttt{trigLabelBase}, it has to be done by the user. The first example sets the unit locally for the \texttt{\psplot} back to 1cm, which is needed, because we use this unit on the PostScript side.

It is also possible to set the $x$ unit and $dx$ value to get the labels right. But this needs some more understanding as to how it really works. A $xunit=1.570796327$ sets the unit to $\pi/2$ and a $dx=0.666667$ then puts at every $2/3$ of the unit a tick mark and a label. The length of the $x$-axis is 6.4 units which is $6.4 \cdot 1.570796327 \, \text{cm} \approx 10 \, \text{cm}$. The function then is plotted from 0 to $3\pi = 9.424777961$. 

```latex
\psset{xunit=\texttt{\textbackslash pstRadUnit}}
\begin{pspicture}(-0.5,-1.25)(6.5,1.25)
\psaxes[\texttt{trigLabelBase=6}]{->}(0,0)(-0.5,-1.25)(6.5,1.25)
\end{pspicture}
```

```latex
\psset{xunit=\texttt{\textbackslash pstRadUnit}}
\begin{pspicture}(-0.5,-1.25)(6.5,1.25)
\psaxes[\texttt{trigLabelBase=3}]{->}(0,0)(-0.5,-1.25)(6.5,1.25)
\psplot[xunit=\texttt{1cm},\texttt{linecolor=red},\texttt{linewidth=1.5pt}]{0}{\texttt{\psPiTwo}}{\texttt{x \texttt{RadtoDeg} \texttt{sin}}}
\end{pspicture}
```

```latex
\psset{xunit=\texttt{\textbackslash pstRadUnit}}
\begin{pspicture}(-0.5,-1.25)(6.5,1.25)
\psaxes[\texttt{dx=1.5}]{->}(0,0)(-0.5,-1.25)(6.5,1.25)
\psplot[xunit=\texttt{0.5cm},\texttt{linecolor=red},\texttt{linewidth=1.5pt}]{0}{\texttt{\psPiFour}}{\texttt{x \texttt{RadtoDeg} \texttt{sin}}}
\end{pspicture}
```

```latex
\psset{xunit=\texttt{\textbackslash pstRadUnit}}
\begin{pspicture}(-0.5,-1.25)(6.5,1.25)
\psaxes[\texttt{dx=0.75},\texttt{trigLabelBase=2}]{->}(0,0)(-0.5,-1.25)(6.5,1.25)
\psplot[xunit=\texttt{0.5cm},\texttt{linecolor=red},\texttt{linewidth=1.5pt}]{0}{\texttt{\psPiFour}}{\texttt{x \texttt{RadtoDeg} \texttt{sin}}}
\end{pspicture}
```
Option triglabels

\begin{pspicture}(-0.5,-1.25)(10,1.25)
\psaxes[xunit=\psPiH, trigLabelBase=3, dx=0.666667]{->}(0,0)(-0.5,-1.25)(6.4,1.25)
\psplot[linecolor=red, linewidth=1.5 pt]{0}{9.424777961}{
\x\text{ RadtoDeg} \text{ dup } \sin \text{ exch } 1.1 \text{ mul } \cos \text{ add}
}
\end{pspicture}

\psset{unit=1 cm}
\begin{pspicture}(-0.5,-1.25)(10,1.25)
\psplot[linecolor=red, linewidth=1.5 pt]{0}{150.80}{\x\text{ RadtoDeg} \text{ dup } \sin \text{ exch } 1.1 \text{ mul } \cos \text{ add}}
\end{pspicture}

\psset{unit=1 cm}
\begin{pspicture}(-0.5,-1.25)(10,1.25)
\psplot[linecolor=red, linewidth=1.5 pt]{0}{150.80}{\x\text{ RadtoDeg} \text{ dup } \sin \text{ exch } 1.1 \text{ mul } \cos \text{ add}}
\end{pspicture}
The setting of trigonometrical labels with `ytriglabels=true` for the $y$ axis is the same as for the $x$ axis.
Also setting labels for the $x$ axis is possible with `trigLabels=true` or alternatively with `ytrigLabels=true`.
\psset{unit=1cm}
\begin{pspicture}(-6.5,-7)(6.5,7.5)
\psaxes[trigLabels, xtrigLabelBase=2, ytrigLabelBase=3, dx=\psPiH, xunit=\psPi, Dy=2]{->}(0,0)(-1.7,-6.5)(1.7,6.5)[x$\pi$,0][y$90$]
\end{pspicture}
9.15. Option ticks

Syntax:

\texttt{ticks=all|x|y|none}

This option was already in the \texttt{pst-plot} package and only mentioned here for some completeness.

\begin{verbatim}
\psset{ticksize=6pt}
\begin{pspicture}(-1,-1)(2,2)
\psaxes[ticks=all, subticks=5]{->}(0,0)(-1,-1)(2,2)
\end{pspicture}
\end{verbatim}

\begin{verbatim}
\begin{pspicture}(-1,-1)(2,2)
\psaxes[ticks=y, subticks=5]{->}(0,0)(-1,-1)(2,2)
\end{pspicture}
\end{verbatim}

\begin{verbatim}
\begin{pspicture}(-1,-1)(2,2)
\psaxes[ticks=x, subticks=5]{->}(0,0)(2,2)(-1,-1)
\end{pspicture}
\end{verbatim}

\begin{verbatim}
\begin{pspicture}(-1,-1)(2,2)
\psaxes[ticks=none, subticks=5]{->}(0,0)(2,2)(-1,-1)
\end{pspicture}
\end{verbatim}
9.16. Option tickstyle

Syntax:

\begin{verbatim}
\psset{subticks=10}
\begin{pspicture}(-1,-1)(3,3)
\psaxes[tickstyle=full]{->}(3,3) \end{pspicture}
\begin{pspicture}(-1,-1)(3,3)
\psaxes[tickstyle=top]{->}(3,3) \end{pspicture}
\begin{pspicture}(-1,-1)(3,3)
\psaxes[tickstyle=bottom]{->}(3,3) \end{pspicture}
\begin{pspicture}(-1,-1)(3,3)
\psaxes[axesstyle=frame, tickstyle=inner, ticksize=0 4pt]{->}(3,3) \end{pspicture}
\end{verbatim}

9.17. Options ticksize, xticksize, yticksize

With this new option the recent tickstyle option of \texttt{pst-plot} is obsolete and no longer supported by \texttt{pstricks-add}.

Syntax:

\begin{verbatim}
ticksize=value[unit]
ticksize=value[unit] value[unit]
xticksize=value[unit]
xticksize=value[unit] value[unit]
yticksize=value[unit]
yticksize=value[unit] value[unit]
\end{verbatim}

ticksize sets both values. The first one is left/below and the optional second one is right/above of the coordinate axis. The old setting tickstyle=bottom is now easy to realize, e.g.: \texttt{ticksize=-6pt 0}, or vice versa, if the coordinates are set from positive to negative values.
A grid is also possible by setting the values to the max/min coordinates.
9.18. Options subticks, xsubticks, and ysubticks

Syntax:

<table>
<thead>
<tr>
<th>subticks=&lt;number&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>xsubticks=&lt;number&gt;</td>
</tr>
<tr>
<td>ysubticks=&lt;number&gt;</td>
</tr>
</tbody>
</table>

By default subticks cannot have labels.

\begin{pspicture}(-1,-1)(2,2)
\psaxes[\text{ticks=all, xsubticks=5, ysubticks=10}]{->}(0,0)(-1,-1)(2,2)
\end{pspicture}

\begin{pspicture}(-1,-1)(2,2)
\psaxes[\text{ticks=y, xsubticks=5}]{->}(0,0)(-1,-1)(2,2)
\end{pspicture}

\begin{pspicture}(-1,-1)(2,2)
\psaxes[\text{ticks=x, xsubticks=5}]{->}(0,0)(2,2)(-1,-1)
\end{pspicture}

\begin{pspicture}(-1,-1)(2,2)
\psaxes[\text{ticks=none, xsubticks=5}]{->}(0,0)(2,2)(-1,-1)
\end{pspicture}

9.19. Options subticksize, xsubticksize, ysubticksize

subticksize sets both values, xsubticksize only for the $x$-axis and ysubticksize only for the $y$-axis, which must be relative to the ticksize length and can have any number. 1 sets it to the same length as the main ticks.

Syntax:

<table>
<thead>
<tr>
<th>subticksize=value</th>
</tr>
</thead>
<tbody>
<tr>
<td>xsubticksize=value</td>
</tr>
<tr>
<td>ysubticksize=value</td>
</tr>
</tbody>
</table>
9.20. Options `tickcolor`, `xtickcolor`, `ytickcolor`, `subtickcolor`, `xsubtickcolor`, and `ysubtickcolor`

Syntax:

```latex
\psset{yunit=1.5cm,xunit=3cm}
\begin{pspicture}(-1.25,-4.75)(3.25,.75)
\psaxes[xticksize=-4.5 0.5,ticklinestyle=dashed,subticks=5,xsubticksize=1,%
ysubticksize=0.75,xsubticklinestyle=dotted,xsubtickwidth=1pt, subtickcolor=gray]{->}(0,0)(-1,-4)(3.25,0.5)
\end{pspicture}
```

```
\psaxes[yAxis=false,labelFontSize=\scriptstyle,ticksize=0 10mm,subticks=10, subticksize=0.75, tickcolor=red,subtickcolor=blue,tickwidth=1pt,subtickwidth=0.5pt](10.01,0)
```

```
\begin{pspicture}(0,-0.75)(10,1)
\psaxes[xAxis=false,labelFontSize=\scriptstyle,ticksize=0 10mm,subticks=10, subticksize=0.75, tickcolor=red,subtickcolor=blue,tickwidth=1pt,subtickwidth=0.5pt](10.01,0)
\end{pspicture}
```
9.21. Options ticklinestyle, xticklinestyle, yticklinestyle,
subticklinestyle, xsubticklinestyle, and ysubticklinestyle

Syntax:

\begin{verbatim}
ticklinestyle=solid|dashed|dotted|none
xticklinestyle=solid|dashed|dotted|none
yticklinestyle=solid|dashed|dotted|none
subticklinestyle=solid|dashed|dotted|none
xsubticklinestyle=solid|dashed|dotted|none
ysubticklinestyle=solid|dashed|dotted|none
\end{verbatim}

ticklinestyle and subticklinestyle set both values for the x and y axis. The value
none doesn’t really makes sense, because it is the same as [sub]ticklines=0

9.22. logLines

Syntax:

\begin{verbatim}
logLines=all|x|y
\end{verbatim}

By default the option logLines sets the ticksize to the maximal length for x, y, or both.
It can be changed, when after the option logLines the ticksize is set.
9.23. xylogBase, xlogBase and ylogBase

There are additional options xylogBase, xlogBase, ylogBase to get one or both axes with logarithmic labels. For an interval of $[10^{-3}, 10^2]$ choose a PStricks interval of $[-3,2]$. PStricks takes 0 as the origin of this axes, which is wrong if we want to have a logarithmic axes. With the options 0y and 0x we can set the origin to $-3$, so that the first label gets $10^{-3}$. If this is not done by the user then pst-plot does it by default. An alternative is to set these parameters to empty values $0x={},0y={}$, in this case the package does nothing.

9.24. xylogBase

This mode in math is also called double logarithmic. It is a combination of the two foregoing modes and the function is now $y = \log x$ and is shown in the following example.
9.25. \texttt{ylogBase}

The values for the \texttt{psaxes} y-coordinate are now the exponents to the base 10 and for the right function to the base $e$: $10^{-3} \ldots 10^1$ which corresponds to the given y-interval $-3 \ldots 1.5$, where only integers as exponents are possible. These logarithmic labels have no effect on the internally used units. To draw the logarithm function we have to use the math function
\[
y = \log \{ \log x \}
\]
\[
y = \ln \{ \ln x \}
\]
with an drawing interval of 1.001 \ldots 6.
\begin{pspicture}(-0.5,-3.5)(6.5,1.5)
\psplot[linewidth=2pt,plotpoints=100,\nlinecolor=red]{1.04}{6}{\ln \{ \log 0.4343 \} \def \{x\nln \ln \} \% log(x)\npsaxes[ylogBase=e,0y=-3]{->}(0,-3)(6.5,1.5)\n\uput[-90](6.5,-3){x}\n\uput[0](0,1.5){y}\nrput(5,1)\{$y=\ln x$}\nend\pspicture
\end{pspicture}

\begin{pspicture}(-0.5,1.75)(6.5,4.5)
\psaxes[ylogBase=10,0y=2]{->}(0,2)(0,2)(6.5,4.5)\nend\pspicture
\begin{pspicture}(-0.5,-0.25)(6.5,4.5)
\psplot{0}{6}{x x \cos add log} \n\psplot[linecolor=red]{0}{6}{x 3 \exp x \cos add log} \n\psplot[linecolor=cyan]{0}{6}{x 5 \exp x \cos add log} \n\psaxes[ylogBase=10]{->}(0,-1)(0,-1)(6.5,4.5)\nend\pspicture
\begin{pspicture}(-0.5,-1.25)(6.5,4.5)
\psplot{0}{6}{x x \cos add log} \n\psplot[linecolor=red]{0}{6}{x 3 \exp x \cos add log} \n\psplot[linecolor=cyan]{0}{6}{x 5 \exp x \cos add log} \n\psaxes[ylogBase=10]{->}(0,-1)(0,-1)(6.5,4.5)\nend\pspicture
9.26. xlogBase

Now we have to use the easy math function $y = x$ because the x axis is still log $x$. 

$$
\begin{pspicture}(2.5,1.75)(6.5,4.5)
\psplot[linestyle=cyol]{3}{6}{x 5 exp x cos add log} % x^5 + \cos(x)
\psaxes[ylogBase=10,0x=3,0y=2](-3,3,6,4.5)
\end{pspicture}
$$

$$
\begin{pspicture}(-3.5,-3.5)(3.5,3.5)
\psplot[linecolor=red]{-3}{3}{x}
\psplot[linecolor=blue]{-0.4343}{1.5}{x}
\psaxes[xlogBase=10,0y=-3,0x=-3](-3,-3,3.5)
\uput[-90](3.5,-3){x}
\uput[180](-3,3.5){y}
\rput(2.5,2.5){$y = \log x$}
\rput{\texttt{lb}}(0,1.5){$y = \ln x$}
\end{pspicture}
$$

$$
\begin{pspicture}(-1.25,-1.25)(4.25,1.5)
\psset{yunit=3cm,xunit=2cm}
\begin{pspicture}(-2.5,-2.5)(4.25,1.5)
\uput[-90](4.25,-1){x}
\end{pspicture}
$$

$$
\begin{pspicture}(-1.25,-1.25)(4.25,1.5)
\psset{yunit=3cm,xunit=2cm}
\begin{pspicture}(-2.5,-2.5)(4.25,1.5)
\uput[-90](4.25,-1){x}
\end{pspicture}
$$
9.27. No logstyle (xylogBase={})

This is only a demonstration that the default option ={} still works ... :-)

\begin{pspicture}(-3.5,-2.5)(3.5,2.5)
\psaxes[xlogBase=10](-3.5,-2.5)(3.5,2.5)
\psplot{-2.5}{2.5}{10 \times \exp \log}
\end{pspicture}

\begin{pspicture}(-3.5,-2.5)(3.5,2.5)
\psaxes[xlogBase=10](-3.5,-2.5)(3.5,2.5)
\psplot{-2.5}{2.5}{10 \times \exp \log}
\end{pspicture}
9.28. Option tickwidth and subtickwidth

\psset{arrowscale=3,arrows=-<\text{D},yAxis=false}
\psaxes[subticks=8](0,0)(-5,-1)(5,1)[1cm]
\psaxes[subticks=4,ticksize=-4pt, xlabelPos=top](0,0)(5,1)(-5,-1)[1cm]
\psaxes[subticks=4,ticksize=10pt](0,0)(5,5)(-5,-5)[1cm]
\psaxes[subticks=10,ticksize=0,-10pt](0,0)(5,5)(-5,-5)[1cm]
\psaxes[subticks=4,ticksize=0,10pt,xlabelPos=bottom](0,0)(5,5)(-5,-5)[1cm]
\psaxes[subticks=4,ticksize=0,-10pt,xlabelPos=top](0,0)(5,5)(-5,-5)[0.25cm]
\psaxes[subticks=0, xlabelPos=bottom](0,0)(-5,-5)(5,5)[1cm]
\psaxes[subticks=0,tickcolor=red,linecolor=blue,xlabelPos=top](0,0)(5,5)(-5,-5)[1cm]
\psaxes[subticks=5,tickwidth=2pt,subtickwidth=1pt](0,0)(-5,-5)(5,5)[1cm]
\psaxes[subticks=0,tickcolor=red,xlabelPos=top](0,0)(5,5)(-5,-5)
9.28. Option `tickwidth` and `subtickwidth`
9.28. Option \texttt{tickwidth} and \texttt{subtickwidth}

\begin{verbatim}
\pspicture(5,5.5)
  \psaxes[subticks=5, ticksize=0 6pt, subticksize =0.5]{->}(5.4,5)
\endpspicture
\end{verbatim}

\begin{verbatim}
\pspicture(-3,-3)(3,3.5)
  \psaxes[subticks=5, ticksize=-6pt 0, subticksize =0.5]{->}(0,0)(3,3)(-3,-3)
\endpspicture
\end{verbatim}

\begin{verbatim}
\pspicture(0,0.5)(-3,-3)
  \psaxes[subticks=5, ticksize=-6pt 0, subticksize=0.5, linecolor=red]{->}(-3,-3)
\endpspicture
\end{verbatim}
9.28. Option tickwidth and subtickwidth

\psset{axesstyle=frame}
\pspicture(5,5.5)
\psaxes[subticks=4, tickcolor=red, subtickcolor=blue](5,5)
\endpspicture

\pspicture(5,5.5)
\psaxes[subticks=5, subticksize=1, subtickcolor=lightgray](5,5)
\endpspicture

\pspicture(5,5.5)
\psaxes[subticks=2, subticksize=1, subtickcolor=lightgray](5,5)
\endpspicture

\pspicture(3,4.5)
\psaxes[subticks=5, ticksize=-7pt 0](3,4)
\endpspicture
A simple grid can be set with the optional argument `psgrid` which uses the setting of `gridpara` and `gridcoor`. `gridpara` is preset to

```
\gridpara={gridlabels=0pt,gridcolor=red!30,subgridcolor=green!30, subgridwidth=0.5\pslinewidth,subgriddiv=5},...
```
10. New options for \readdata

By default the macro \readdata reads every data record, which could be annoying when you have some text lines at top of your data files or when there are more than 10000 records to read.

\texttt{\pstr执意\dash\text{-\pstr执意\dash\data\pstr执意\dash\9.\pstr执意\dash\\pstr执意\dash\data\pstr执意\dash\pstr执意\dash\TEXT{-\pstr执意\dash\data\pstr执意\dash\pstr执意\dash\9.\pstr执意\dash\data\pstr执意\dash\pstr执意\dash\pstr执意\dash\\pstr执意\dash\}}

The default value for \texttt{ignoreLines} is 0 and for \texttt{nStep} is 1. the following data file has two text lines which shall be ignored by the \texttt{\readdata} macro:

\begin{filecontents*}{\pstr执意\dash\\pstr执意\dash\data\pstr执意\dash\pstr执意\dash\9.\pstr执意\dash\data\pstr执意\dash\pstr执意\dash\pstr执意\dash\\pstr执意\dash\}}
\texttt{some nonsense in this line ---time forcex forcey 0 0.2 1 1 2 4 \end{filecontents*}}

\begin{pspicture}(2,4)
\listplot[showpoints]{\data}
\psaxes{-}[(2,4)]
\endpspicture
11. New options for \listplot

By default the plot macros \dataplot, \fileplot and \listplot plot every data record. There are new additional keys \nStep, \nStart, \nEnd, and \xStep, \xStart, \xEnd, which allows to plot only a selected part of the data records, e.g. \nStep=10. These "'n" options mark the number of the record to be plotted (0, 1, 2,...) and the "'x" ones the x-values of the data records.

The new options are only available for the \listplot macro, which is not a real limitation, because all data records can be read from a file with the \readdata macro (see example files or [?]):

\readdata[nStep=10]{\data}{/home/voss/data/data1.data}

The use \nStep and \xStep options only make real sense when also using the option \plotstyle=dots. Otherwise the coordinates are connected by a line as usual. Also the \xStep option needs increasing x values. Note that \nStep can be used for \readdata and for \listplot. If used in both macros then the effect is multiplied, e.g. \readdata with \nStep=5 and \listplot with \nStep=10 means, that only every 50th data record is read and plotted.

When both, \xStart/End are defined then the values are also compared with both values.

11.1. Options \nStep, \xStep, and \yStep

The datafile \data.data contains 1000 data records. The thin blue line is the plot of all records with the \plotstyle option \curve.

\readdata{\data}{data.data}
\psset{xunit=12.5cm,yunit=0.2mm}
\begin{pspicture}(-0.080,-30)(1,270)
\pstScalePoints(1,1){1000 div}{1000 div}
\psaxes[Dx=200,dx=2.5cm,Dy=100,ticksize=0 5pt,tickstyle=inner, subticks=10,ylabelFactor=\cdot 10^3,dy=2cm](0,0)(1,250)
\listplot[nStep=50,linewidth=3pt,linestyle=dots]{\data}
\listplot[linewidth=1pt,linestyle=dots]{\data}
\end{pspicture}
\readdata{data.data}
\psset{xunit=12.5cm,yunit=0.2mm}
\begin{pspicture}(-0.080,-30)(1,270)
\pstScalePoints(1,1){1000 div}{1000 div}
\psaxes[Dx=200,dx=2.5cm,Dy=100,ticksize=0 5pt,tickstyle=inner, subticks=10,ylabelFactor=\cdot 10^3,dy=2cm](0,0)(1,250)
\listplot[xStep=100,linewidth=2pt,linecolor=red,plotstyle=dots]{data}
\multido{\rA=0.1+0.1}{9}%
\psline[linecolor=black!40,linestyle=dashed](\rA,0)(\rA,250)
\listplot[yStep=50000,linewidth=2pt,linecolor=blue,plotstyle=dots]{data}
\multido{\nA=50+50}{5}%
\psline[linecolor=black!40,linestyle=dashed](0,\nA)(1,\nA)
\listplot[linewidth=0.5pt]{data}
\end{pspicture}
11.2. Options nStart and xStart

\begin{pspicture}(-0.080,-30)(1,270)
\psaxes[Dx=200,dx=2.5\text{cm},Dy=100,ticksize=0.5\text{pt},tickstyle=inner,subticks=10,ylabelFactor=\cdot10^3,dy=2\text{cm}](0,0)(1,250)
\listplot[nStart=200,linewidth=3\text{pt},linecolor=blue,plotstyle=dots]{\text{data}}
\listplot[linewidth=1\text{pt},linecolor=blue]{\text{data}}
\end{pspicture}
11.3. Options nEnd and xEnd

\begin{pspicture}(-0.080,-30)(1,270)
\psScalePoints(1,1){1000 div}{1000 div}
\psaxes[axesstyle=frame,Dx=200,dx=2.5cm,Dy=100,ticksize=0 5pt,tickstyle=inner,subticks=10,ylabelFactor=\cdot 10^3,dy=2cm](0,0)(1,250)
\listplot[nStart=200,linewidth=3pt,linecolor=blue]{\data}
\listplot[linewidth=1pt,linecolor=blue]{\data}
\end{pspicture}
11.4. Options yStart and yEnd

By default the plot macros expect x|y data records, but when having data files with multiple values for y, like:

\begin{verbatim}
x y1 y2 y3 y4 ... yMax
x y1 y2 y3 y4 ... yMax
...
\end{verbatim}

you can select the y value which should be plotted. The option plotNo marks the plotted value (default 1) and the option plotNoMax tells pst-plot how many y values are present. There are no real restrictions in the maximum number for plotNoMax.

We have the following data file:

\begin{verbatim}
% file data.data
0 0 3.375 0.0625
10 5.375 7.1875 4.5
20 7.1875 8.375 6.25
30 5.75 7.75 6.6875
40 2.1875 5.75 5.9375
50 -1.9375 2.1875 4.3125
60 -5.125 -1.8125 0.875
\end{verbatim}
which holds data records for multiple plots (x y1 y2 y3). This can be plotted without any modification to the data file:

It is also possible to select another column for the x-value. Suppose we have a data base with records like x y x y x y, then it is by default a record with one x value and four possible y values. We still have to define plotNoMax=4. However, it is possible to select the forth value as new x value by setting plotNoX=4 (it is preset to 1). Then the forth value is taken as x. The example uses the the following data set.

<table>
<thead>
<tr>
<th>X1</th>
<th>X2</th>
<th>Y1</th>
<th>Y2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>55.1500</td>
<td>10.35</td>
<td>11.26</td>
</tr>
<tr>
<td>31</td>
<td>59.7167</td>
<td>11.06</td>
<td>11.11</td>
</tr>
</tbody>
</table>
11.5. Options plotNo, plotNoX, and plotNoMax

\readdata\{data\}{demo.txt}
\psset\{xAxisLabel={}, yAxisLabel={},llx=-5mm\}
\begin{psgraph}\{axesstyle=frame,Dy=5,Dx=10,ticksize=5pt\}\{0,0\}(100,25)\{10cm\}{8cm}
\psset\{dotstyle=square,dotscale=1.5,linewidth=1.5pt\}
\listplot\{plotNoMax=3,plotNo=2,linecolor=red,plotstyle=dots\}\{data\}
\listplot\{plotNoMax=3,plotNoX=2,plotNo=3,linecolor=blue,plotstyle=dots\}\{data\}
\end{psgraph}
11.6. Option changeOrder

It is only possible to fill the region between two listplots with \texttt{pscustom} if one of them has the values in reverse order. Otherwise we do not get a closed path. With the option \texttt{ChangeOrder} the values are used in reverse order:

\begin{filecontents*}{test.data}
0 3 8
2 4 7
5 5 5.5
7 3.5 5
10 2 9
\end{filecontents*}
\psset{ll=\text{-}.5cm}
\begin{psgraph}[axesstyle=frame,ticklinestyle=dotted,ticksize=0 10](0,0)(10,10)\pscustom[fillstyle=solid,fillcolor=blue!40]{\listplot[plotNo=2,plotNoMax=2]{data}}\listplot[plotNo=1,plotNoMax=2,ChangeOrder]{data}\end{psgraph}
12. New plot styles

12.1. Plot style colordot and option Hue

The plotted dots can be colored with the HSB color model, where Hue is set by an angle (0…360) and the values of Saturation and Brightness are set by the relative $y$ value of the data records. The default value for Hue is 180.

```
\readdata{data}{data3.data}
\psset{xunit=10,yunit=0.02}
\begin{pspicture}(0,-50)(1.1,400)
  \psaxes[dy=1cm,Dy=50]{->}(0,0)(0,-50)(1.1,400)
  \listplot[Hue=280,plotstyle=colordots]{data}
\end{pspicture}
```
12.2. Plot style bar and option barwidth

This option allows you to draw bars for the data records. The width of the bars is controlled by the option barwidth, which is set by default to value of 0.25 cm, which is the total width.

\begin{pspicture}(-2,-3)(29,13)
\psaxes[axesstyle=axes,Ox=1466,Oy=0,Dx=4,Dy=2,xticksize=-6pt 0, ylabelFactor=\%,\%]{-}(29,12)
\listplot[shadow=true,linestyle=blue,plotstyle=bar,barwidth=0.3 cm, fillcolor=red,fillstyle=grid]{\barData}
\rput(90)(-3,6.25){Amount}
\end{pspicture}
12.2. Plot style bar and option barwidth

Interrupted bar plot

The new keywords interrupt takes three comma separated values: the value, when the interrupted $y$ axis is interrupts, the separation for the drawn tilde and the value for the uninterrupted section, e.g. interrupt={15,1,30}.

\psset{xunit=.44cm,yunit=.3cm}
\begin{pspicture}(-2,-3)(29,13)
\psaxes[axesstyle=axes,Ox=1466,0y=0,Dx=4,Dy=2,ticksize=-4pt 0,
 ylabelFactor={\%}\{-}(29,12)
\listplot[linecolor=blue,plotstyle=bar,barwidth=0.3cm,
 fillcolor=red,fillstyle=vlines]{\barData}
\listplot[showpoints=true]{\barData}
\rput{90}(-3,6.25){Amount}
\end{pspicture}
12.3. Plot style ybar

With the setting plotstyle=ybar the graph is set with horizontal bars instead of vertical. For yLabels see section ???
12.4. Plotstyle LSM

With the setting plotstyle=LSM (Least Square Method) the data records are not printed in the usual way as dots or a line, the \texttt{listplot} macro calculates the values for a line $y = v \cdot x + u$ which fits best all data records.
The macro looks for the lowest and biggest x-value and draws the line for this interval. It is possible to pass other values to the macro by setting the \texttt{xStart} and/or \texttt{xEnd} options. They are preset with an empty value \{\}. 

\[ y = 0.755679 \times 1.84105 \]

\begin{filecontents*}[overwrite]{LSM.data}
0 1 1 3 2.8 4 3 2.9 2 5 4 4 5 5.5 6 8.2 8 7
\end{filecontents*}

\begin{psgraph}[arrows=->](0,0)(0,0)(8,8){.5\textwidth}{!}
\listplot[plotstyle=dots]\{data\}
\listplot[PstDebug,plotstyle=LSM,xStart=-0.5,xEnd=8.5,linewidth=red]\{data\}
\end{psgraph}

With \texttt{PstDebug} one gets the equation \( y = v \cdot x + u \) printed, beginning at the position (0|-50pt). This cannot be changed, because it is only for some kind of debugging. Pay attention for the correct \texttt{xStart} and \texttt{xEnd} values, when you use the \texttt{\textbackslash pstScalePoints} Macro. In the following example we use an x-interval from 0 to 3 to plot the values; first we subtract 0.003 from all x-values and then scale them with 10000. This is not taken into account for the \texttt{xStart} and \texttt{xEnd} values.
\begin{filecontents*}{LSM.data}
0.003298697 1.397785583
0.003193358 1.615489564
0.003094538 2.044019006
0.003001651 2.259240127
\end{filecontents*}
\readdata{\data}{LSM.data}
\pstScalePoints(10000,1){0.003sub}{}
\psset{ly=-1.75cm}
\psgraph[arrows=->,Ox=0.003,Dx=0.0001,dx=\psxunit](0,0)(3.2,3){10cm}{5cm}
\listplot[showpoints=true,linewidth=1pt,linecolor=blue]{\data}
\listplot[PstDebug=1,plotstyle=LSM,linewidth=0.1pt,linestyle=dashed,]
\begin{psgraph}[arrows=-,xStart=-0.25,xEnd=3.3]{data}
\end{psgraph}
12.5. Plot styles values and values*

Instead of plotting the curve with the setting `plotstyle=values` the $y$-values are printed at the current point.

The possible optional arguments are `PSfont`, `valuewidth`, `fontscale`, and `decimals`. The default setting is:

```
pset[pst-plot]{PSfont=Times-Roman,fontscale=10,valuewidth=10,decimals=-1}
```

The optional argument `rot` from the base package `pstricks` is also taken into account. With the star version `plotstyle=values*` the box of the printed value isn’t transparent, everything behind this box is not seen.
12.6. Plotstyles \texttt{xvalues} and \texttt{xvalues*}

This is similar to the options \texttt{values}, except that it plots the $x$-values instead of the $y$-values. This may be useful when also using the plotstyle \texttt{ybar} (see Section 12.3 on page 76).
13. Polar plots

With the option `polarplot=false|true` it is possible to use any plot command in polar mode:

```
p????plot [polarplot,...] {<start angle}>|{end angle}>% [PS command] {<r(alpha)>}
```

The equation in PostScript code is interpreted as a function \( r = f(\alpha) \), e.g. for the circle with radius 1 as \( r = \sqrt{\sin^2 x + \cos^2 x} \), or \( r = a \frac{\sin x \cos x}{(\sin x)^3 + \cos(x)^3} \) for the following examples:

```ps
x sin dup mul x cos dup mul add sqrt
```

\[ \text{\begin{center} \begin{pspicture}(5.1,5.1) \psset{linecolor=red}\psplot{140}{310}{3 neg x sin mul x cos mul x sin 3 exp x cos 3 exp add div} \psplot{140}{310}{6 x sin mul x cos mul x sin 3 exp x cos 3 exp add div} \psplot[algebraic]{2.44}{5.41}{-8*\sin(x)*\cos(x)/(\sin(x)^3+\cos(x)^3)} \end{pspicture}\end{center}} \]

\[ \text{\begin{center} \begin{pspicture}(5.1,5.1) \psset{plotpoints=200,unit=0.75} \begin{psaxes}[arrowlength=1.75,ticksize=2pt,labelFontSize=\scriptstyle, linewidth=0.2mm]{-}{}{0,0}{-4.99,-4.99}{(5,5)}[x,-90][y,180] \rput[Br]{\cdot.15,\cdot.35}{\$0\$} \psset{linewidth=.35mm,polarplot}\psplot[linecolor=red]{140}{310}{3 neg x sin mul x cos mul x sin 3 exp x cos 3 exp add div} \psplot[linecolor=cyan]{140}{310}{6 x sin mul x cos mul x sin 3 exp x cos 3 exp add div} \psplot[linecolor=blue,algebraic]{2.44}{5.41}{-8*\sin(x)*\cos(x)/(\sin(x)^3+\cos(x)^3)} \end{pspicture}\end{center}} \]
\psset{unit=0.5cm}
\begin{pspicture}(-6,-6)(6,6)
\psaxes[axesstyle=polar,labelFontSize=\scriptstyle,linewidth=0.2mm]{->}(6,6)
\psset{linewidth=3pt,polarplot,plotpoints=500,plotstyle=curve}
\psplot[linecolor=red]{140}{310}{3 neg x sin mul x cos mul x sin 3 exp x cos 3 exp add div}
\psplot[linecolor= cyan]{140}{310}{6 x sin mul x cos mul x sin 3 exp x cos 3 exp add div}
\psplot[linecolor=blue,algebraic]{2.44}{5.41}{-8*sin(x)*cos(x)/(sin(x)^3+cos(x)^3)}
\endpsclip
\end{pspicture}

\psset{plotpoints=200,unit=1}
\begin{pspicture}(-2.5,-2.5)(2.5,2.5)
\psaxes[arrowlength=1.75,%
ticks=2pt,linewidth=0.17mm]{->}%(0,0)(-2.5,-2.5)(2.5,2.5)[$x$,90][$y$,180]
\rput[Br](-.15,-.35){$0$}
\psset{linewidth=.35mm,plotstyle=curve,polarplot}
\psplot[linecolor=red]{0}{360}{x cos 2 mul x sin mul}
\psplot[linecolor=green]{0}{360}{x cos 3 mul x sin mul}
\psplot[linecolor=blue]{0}{360}{x cos 4 mul x sin mul}
\end{pspicture}
13. Polar plots

\psset{plotpoints=200,unit=0.5}
\begin{pspicture}(-8.5,-8.5)(9,9)
  \psaxes[Dx=2,dx=2,Dy=2,dy=2,arrowlength=1.75,ticksize=2pt,linewidth=0.17mm](-8.5,-8.5)(9,9)
  \rput[Br](9,-.7){$x$}
  \rput[tr](-.3,9){$y$}
  \rput[Br](-.3,-.7){0}
  \psset{linewidth=.35mm,plotstyle=curve,polarplot}
  \psplot[linecolor=blue]{0}{720}{8 2.5 x mul sin mul}
\end{pspicture}
14. New macros

14.1. \psCoordinates

\psCoordinates [Options] (x, y)
14.2. \psFixpoint

\psFixpoint [Options] \{x_0\}\{f(x)\}\{n\}

\(x_0\) is the start value of the iteration, \(f(x)\) the function, which can either be in postfix or algebraic notation, for the latter it needs the optional argument \texttt{algebraic}. The number of the iteration is given by \(n\).
14.3. \texttt{psNewton}

\texttt{\textbackslash psNewton [Options] \{x_0\}\{f(x)\} [f'(x)] \{n\}}

If the optional derivation of the function $f(x)$ is missing, then the macro itself calculates the derivation with an interval of $\pm 0.01$. It can be changed by setting the optional argument \texttt{VarStepEpsilon} to another value. If the derivation is also given as a function, it is used without any check for the values.

$x_0$ is the start value of the iteration, $f(x)$ the function, which can either be in postfix or algebraic notation, for the latter it needs the optional argument \texttt{algebraic}. The number of the iteration is given by $n$. All defined plotstyles can be used, but there
maybe PostScript errors for plotstyle=values if the number of steps is too big. In such a case decrease the number of steps.
14.4. \psVectorfield

\psVectorfield [Options] \((x_0, y_0)(x_1, y_1)\{f'(x, y)\}\)

\(f'(x, y)\) can be in Postfix notation or with option \texttt{algebraic} in Infix notation. The \(\Delta x\) and \(\Delta y\) are given by \texttt{Dx} and \texttt{Dy} and preset to 0.1, the length of the arrow lines is relative and internally set by \(1/Ox\) with a preset of \(Ox=3\).

\%\usepackage{pst-ode}
\begin{pspicture}(-1.2,-1.2)(1.1,1.1)
\psaxes[ticksize=0 4pt,axesstyle=frame,tickstyle=inner,subticks=20,OX=-1,OY=-1](-1,-1)(1,1)
\psset{arrows=-}
\psset{unit=3cm}
\psVectorfield[linecolor=black!60](-0.9,-0.9)(0.9,0.9){x^2+y^2-1}
\pstODEsolve[algebraicOutputFormat]{y0_a}{t | x[0]}{-1}{1}{100}{-0.5}{t^2+x[0]^2-1}
\pstODEsolve[algebraicOutputFormat]{y0_b}{t | x[0]}{-1}{1}{100}{0.0}{t^2+x[0]^2-1}
\pstODEsolve[algebraicOutputFormat]{y0_c}{t | x[0]}{-1}{1}{100}{0.5}{t^2+x[0]^2-1}
\psset{arrows=-,algebraic}
\psset{unit=3cm}
\begin{pspicture}(-1.2,-1.2)(1.1,1.1)
\psaxes[ticksize=0 4pt,axesstyle=frame,tickstyle=inner,subticks=20,OX=-1,OY=-1](-1,-1)(1,1)
\psset{arrows=-}
\psset{unit=3cm}
\psVectorfield[linecolor=black!60](-0.9,-0.9)(0.9,0.9){x^2+y^2-1}
\pstODEsolve[algebraicOutputFormat]{y0_a}{t | x[0]}{-1}{1}{100}{-0.5}{t^2+x[0]^2-1}
\pstODEsolve[algebraicOutputFormat]{y0_b}{t | x[0]}{-1}{1}{100}{0.0}{t^2+x[0]^2-1}
\pstODEsolve[algebraicOutputFormat]{y0_c}{t | x[0]}{-1}{1}{100}{0.5}{t^2+x[0]^2-1}
\psset{arrows=-}
\listplot[linecolor=red,linewidth=1pt]{y0_a}
\listplot[linecolor=green,linewidth=1pt]{y0_b}
\listplot[linecolor=blue,linewidth=1pt]{y0_c}
\end{pspicture}
15. Internals

The last pair of coordinates of \texttt{psplot} and \texttt{psparametricplot} is saved in a PostScript array and can be used as \texttt{FinalState} inside PostScript code.

\begin{verbatim}
\psset{unit=2}
\begin{pspicture}(0,-1)(3,0.5)
 \pscustom[linejoin=1, arrows=-]{% 
   \psline(0,-1)(1,0)
   \psplot[algebraic, plotpoints=100]{1}{2.25}{.25*sin(2*Pi*x/.25)}
   \psline(3,0)
}

 \pscustom[linejoin=1, arrows=-, linecolor=red]{% 
   \psline(0,-1)(1,0)
   \psplot[algebraic, plotpoints=100]{1}{2.25}{.25*sin(2*Pi*x/.25)}
   \psline(! FinalState aload pop ) (3,0)
}
\end{pspicture}
\end{verbatim}
### 16. List of all optional arguments for pst-plot

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### 16. List of all optional arguments for \texttt{pst-plot}

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