# Generating Charts with FASTPICTEX

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Dedicated to
the Free Software Foundation
and all TEX users

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# Chapter 2

# Introduction

When I was writing my doctoral thesis in the late $80^{th}$, I spent my total savings and bought an IBM-compatible personal computer, that was based on a 8080 microprocessor. Of course, I was using LaTeX as text-processing software. Inspired by my brother Bernhard, I decided to use PiCTeX to generate the charts for my thesis. However, I soon recognized that the TeX version that I used at this time (PCTeX) was not suitable to generate PiCTeX charts, since I very often received messages, such as:

```
! TeX capacity exceeded, sorry [main memory size = 65536 bytes]
```

Finally, the excellent TeX implementation from Eberhard Mattes appeared and I could use BigTeX to generate my theses using the MS-DOS operating system. Later, I switched to the Linux operating system that came with the teTeX implementation and memory management was no longer a limitation. Today, I am using the MikTeX implementation of TeX on the MS-Windows Vista operating system. The old original files of my doctoral thesis still run smoothly through MikTeX without modifications and that is 20 years after the thesis was written.

However, the use of PiCTeX for generating charts is still quite time consuming, because the PiCTeX macro language, although very powerful, is somewhat awkward. Pictures must be described by the PiCTeX programming language and usually a lot of debugging is necessary to obtain the desired result. This may be the largest disadvantage of PiCTeX. Otherwise, PiCTeX is very advanced and offers nearly everything necessary to generate very nice charts of scientific data material. In order to overcome the time consuming part of generating the PiCTeX code, I decided to write a PiCTeX-preprocessor that does all the nasty part in generating PiCTeX code. This preprocessor takes a very simple macro file as input and generates an output file containing the PiCTeX code. The output file can then be included in a document by the `\input` command. As with most preprocessors there are

some limitations of FASTPICTEX. First, only numerical diagrams based on data material can be generated. Second, only a limited set of commands are implemented, offering only basic instructions. Therefore, fine tuning the PICTEX code is usually still necessary. However, a working skeleton of the PICTEX file can be generated easily by FASTPICTEX.

# Chapter 3

# Installation and Usage

To use FASTPICTEX you certainly need TEX. TEX was developed by Donald E. Knuth. His TEXbook [1] is the basis of all packages based on the most advanced typesetting software available for almost any computer platform. In addition to TEX you also need LATEX that was developed as an extension to TEX by Leslie Lamport who has written the original LATEX manual [2]. In addition, you need PICTEX that is described in [3]. The PICTEX manual by the author of PICTEX, Michael J. Wichura, is an indepth description of the PICTEX system and is certainly worth to read. The PICTEX manual used to be freely available on the Internet. Currently, it is only available for purchase.

Installation of FASTPICTEX is as simple as unpacking the archive, and running make. A binary executable version of FASTPICTEX for the MS-DOS/Windows operating system is included. Compilation of the program for other operatign systems should be straight forward with any standard C++ compiler (I have used the MinGW Compiler).

```
tar -xzvf fastpictex-x.y.tar.gz
cd fastpictex-x.y/src
make
```

Once you have generated the executable, you are ready to generate PICTEX code in just a few seconds. `fastpictex` is a command line program that accepts two parameters: the input file name and the output file name. The input file is a FASTPICTEX macro file, while the output file is the PICTEX code that can be included in a LATEX document. Thus, running FASTPICTEX is as simple as typing:

```
fastpictex file_in file_out
```

As an example, consider the very simple input file (`bargraph.fpt`) that generates a bargraph with four columns and standard-error bars:

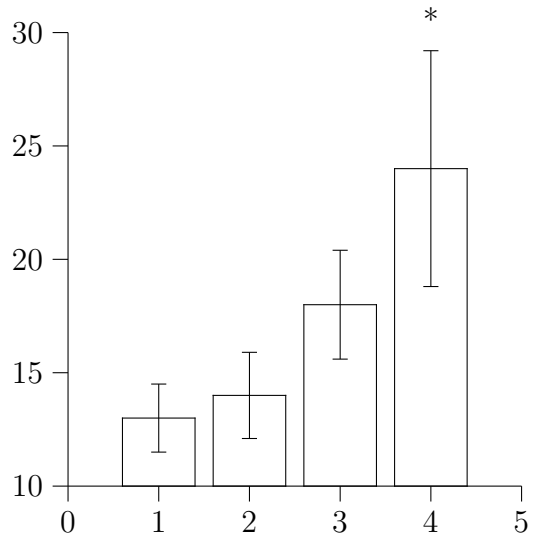


Figure 3.1: This bargraph was produced by FASTPICTEX by only four lines of input code.

```
type  bar
x
y     13  14  18  24"*"
dy    1.5 1.9 2.4 5.2
```

To generate a PICTEX file that can be included in any LATEX file (the PICTEX package must be included) run the command:

```
fastpictex bargraph.fpt bargraph.ltx
```

A LATEX document that includes the bargraph (see Fig. 3.1) generated by FASTPICTEX could be:

```
\documentclass[12pt]{book}
\usepackage{pictex}
\begin{document}
This is a pretty nice bar graph: \\
\input bargraph.ltx
\end{document}
```

# Chapter 4

# The macro language

The FASTPICTEX macro language consists of a few commands that can be used to design a chart. The series of comands that compose a chart are generally written to a file using a text editor, such as emacs or vi. A command always starts in the first column of a line. Following the command word at least one whitespace character must be inserted before the parameters for the command are added. The parameters for the commands are also separated by whitspace characters and can continue in subsequent lines. However, if several lines are used for one command, then the subsequent lines must start with at least one whitespace character (instead of with a command word). As an example, consider the following macro for the line graph shown in Fig. 4.1:

```
type line
x    1 2 3 4 5
     6 7 8 9 10
y    95 100 110 95 105
     110 120 125 145 160
```

In this example, the `x` and `y` commands are spread over two lines. Note, that the second lines for these commands start with whitespace characters. Whitespace characters can be blanks or tabulators.

It is also possible to design charts with more than one series of data. For each series of data, commands must be provided as demonstrated in the next example. The example consists of three series of xy charts. The resulting chart is shown in Fig. 4.2. Note, that the three data series are automatically distinguished by different symbols (i.e. by filled circles, open circles, and by diamonds).

```
type xy
```

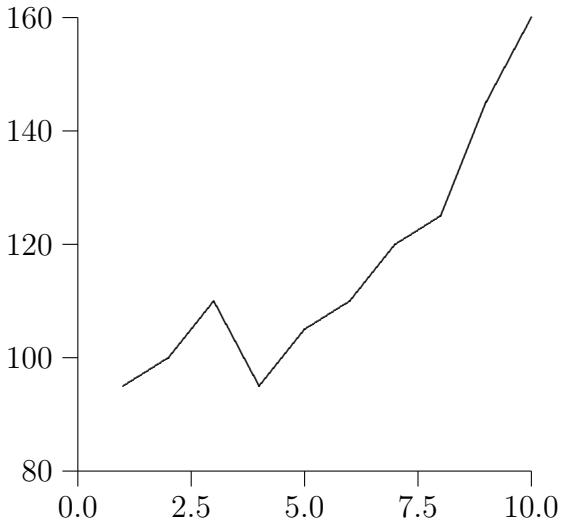


Figure 4.1: A linegraph.

```
x    3.4 5.4 7.5 9.3 12.5
y    12  23  45  32  83 23
type xy
x    1.2 4.5 6.5 6.9
y    4   11  74  62
type xy
x    3.4 5.5 7.8 9.2 10.2 11.8
y    2   3   8   20  18   37
```

In addition, it is possible to combine different graph types in one chart. Consider an example, in which the data points of an XY-Graph should be connected by lines. A macro file for such a chart composition is shown in the next example (Fig. 4.3).

```
type xy
x    1   2   3   4   5
y    9   12  15  17  19
dx   0.5 0.6 0.4 0.5 0.7
dy   0.8 0.9 1.2 2.0 2.4
type line
x    1   2   3   4   5
y    9   12  15  17  19
```

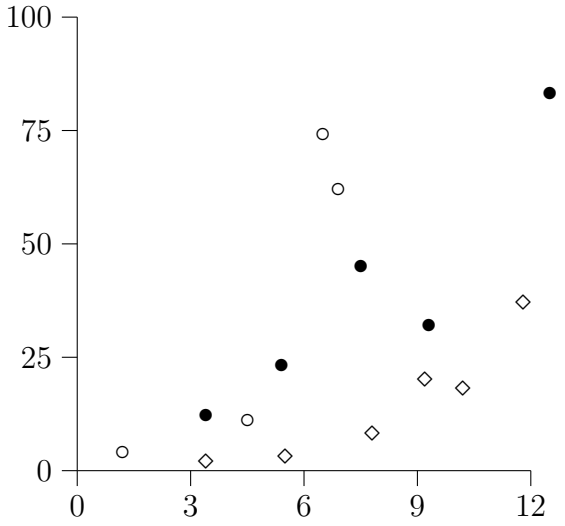


Figure 4.2: A XY-graph with three series.

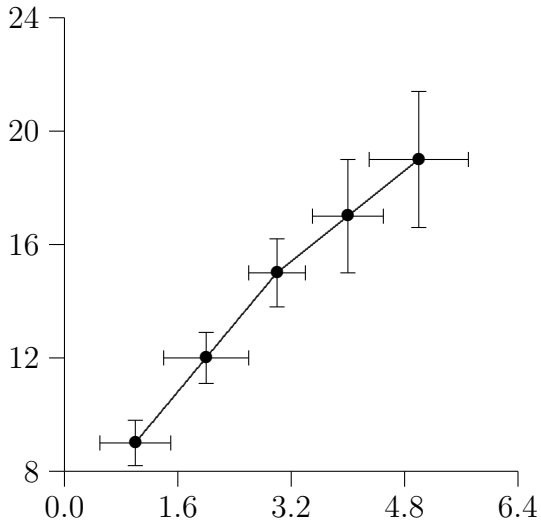


Figure 4.3: A graph with different chart types.

If a chart that consists of several series is to be composed, it is important to understand, how FASTPICTEX handels the order of the commands. If a command word occurs for the first time, the command belongs to the first series. If the command word appears for a second or third time, it belongs to the second or third series. Therefore, the example that generated Fig. 4.3 could have also been written as:

```
type xy
type line
x    1   2   3   4   5
x    1   2   3   4   5
y    9   12  15  17  19
y    9   12  15  17  19
dx   0.5 0.6 0.4 0.5 0.7
dy   0.8 0.9 1.2 2.0 2.4
```

In the following sections of this chapter, the various commands are described in detail. For each command, examples are given as to how to use the commands.

## 4.1 Comments, the % command

To add comments, use the command word %. As an example, the macro code for one of the former examples (Fig 4.3) can be written as:

```
%    first, the XY-Graph with 5 data points
type xy
x    1   2   3   4   5
y    9   12  15  17  19
%    there are standard errors for the x and y-values
dx   0.5 0.6 0.4 0.5 0.7
dy   0.8 0.9 1.2 2.0 2.4
%    here comes the line graph
type line
x    1   2   3   4   5
y    9   12  15  17  19
```

## 4.2 The size command

The size command allows to define the width and height of the plot. The parameters of the size command are the width and the height of the chart

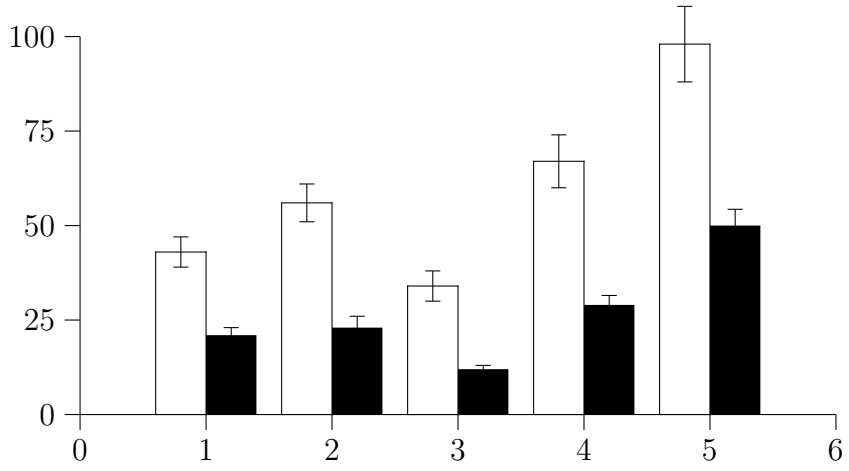


Figure 4.4: An example with a non-standard size.

which must both be given in units of centimeters (cm). If no size command is given, the width and height both default to 6 cm. The output of the following example is shown in figure 4.4.

```
size 10 5
type bar
x
y 43 56 34 67 98
dy 4  5  4  7  10
type bar
x
y 21 23 12 29  50
dy 2  3  1  2.5 4.3
```

## 4.3 The type command

The type command defines what kind of chart should be generated. The available chart types are:

- XY-graphs
- line graphs
- bar graphs

Please keep in mind, that you must enter a type command for every series in your chart. It is **not** possible to define the chart type once for all series!

### 4.3.1 XY-Graphs

To generate a XY-graph, simply use "`type xy`". An example is given in Fig. 4.2. With XY-graphs it is sometimes interesting to study the correlation between the two variables X and Y. With FASTPICTEX this can be accomplished by the "`tline`" command explained later.

### 4.3.2 Line-Graphs

To generate a line-graph, use "`type line`". An example is given in Fig. 4.1.

### 4.3.3 Bar-Graphs

To generate a bar-graph, use the command "`type bar`". An example is given in Fig. 3.1. The x-coordinates of bar-graphs always start at 1 and increase by steps of 1. Therefore, the x command for a bar graph may consist of only the letter x and no actual x-coordinates.

## 4.4 The tline command - Regression lines

The "`tline`" command generates regression lines and the linear regression equation for XY-graphs. The "`tline`" command is followed by a parameter that can be 0, 1, or 2. A parameter of 0 is equivalent to not type the "`tline`" command at all.

`tline 0` no regression line and no linear regression equation.

`tline 1` regression line but no linear regression equation.

`tline 2` regression line and linear regression equation.

Below is the FASTPICTEX code of a small example with regression lines. The corresponding graph is shown in Fig. 4.5. Please note that the linear regression equation is only printed for the second XY-graph because the parameter for the `tline` command for the first XY-graph is "1".

```
type xy
x 1 2 3 4
```

```
y 12 24 29 45
tline 1
type xy
x 0.8 2.2 2.9 3.5 4.2
y 19 37 56 62 76
tline 2
```

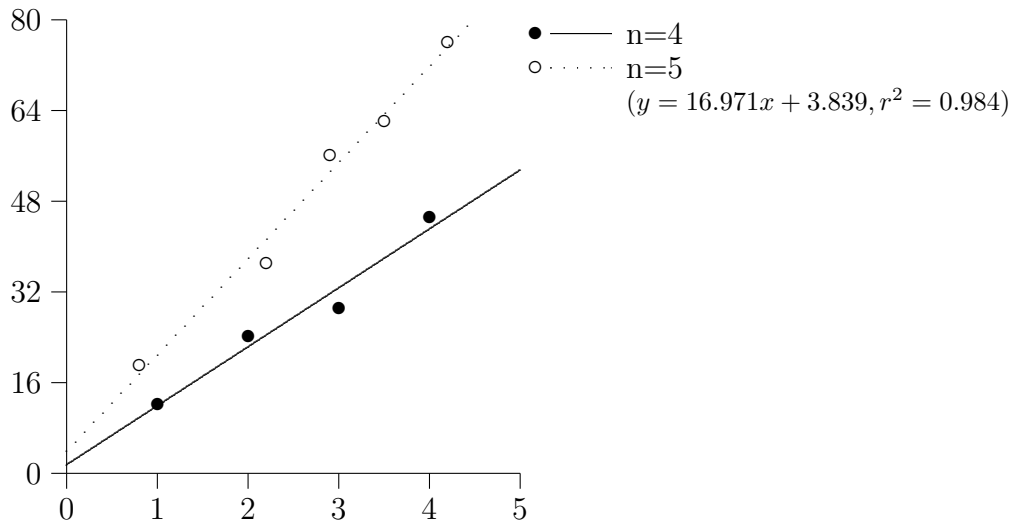


Figure 4.5: A small example with regression lines.

A more complex example of a FastPicTeX file with regression lines is shown below and the corresponding graph is povided in Fig. 4.6. The `\begin{sideways} ... \end{sideways}` environment used in this example requires the rotating package.

```
% ......   start of FastPicTeX file generated by WinStat   ......
size 8 6
heading VLF$_{SYS}$ BPV depends on BP$_{SYS}$
xlabel BP$_{SYS}$ (mmHg)
ylabel \begin{sideways}VLF$_{SYS}$ BPV (mmHg$^2$)\end{sideways}
type xy
x 125.893 122.068 129.876 137.412 118.674 113.696 125.006 125.461
  129.847 118.953 108.51 121.579 119.482 98.8476 142.496 164.389
  123.95 115.166 132.47 144.27 133.035 133.055 154.599 122.92
  128.499 113.579 131.072 162.442 133.192
y 3.16042 8.83067 4.33801 4.30591 5.64648 2.07347 3.18186 11.9516
```

```
  13.1928 13.1314 4.47767 6.47536 5.14432 3.32263 9.65716 13.0522
  7.31404 4.58229 3.1139 10.7105 9.02321 11.5118 8.58124 2.42624
  15.1649 7.05125 7.86681 32.3106 6.79882
tline 2
legend NT-WKY
type xy
x 161.619 138.333 162.657 150.394 137.663 149.359 174.344 160.004
  154.035 136.879 172.018 169.222 227.833 166.556 203.363 217.97
  163.901 295.961 233.824 182.005 187.982 162.076 191.837 191.716
  201.59 190.45 172.915 182.429 171.276 199.674 219.954 209.391
  169.779 234.883 184.092
y 17.7748 12.148 10.9592 19.431 10.0629 12.2948 21.5984 9.37904
  6.58417 6.21308 6.58108 7.00912 25.9094 19.3779 15.4613 22.1531
  20.4522 39.1079 22.859 8.29836 10.9897 18.1887 18.8228 10.0569
  5.96681 18.7384 18.2352 19.3519 10.1097 9.25416 12.3193 9.41323
  18.1815 22.7927 20.5234
tline 2
legend SHR-SP
type xy
x 155.103 165.38 157.281 146.894 158.771 156.589 137.863 144.211
  178.065 159.785 158.811 154.489 199.687 188.904 165.341 216.809
  210.534 175.404 140.475 165.759 191.806 200.337 149.956 160.635
  160.436 158.153 148.533 186.501 177.38 182.737 190.26 197.757
  183.722 170.007 175.68 178.303 176.472 152.316 176.31 218.141
  177.818 214.449
y 14.9306 13.1478 6.61684 13.5918 4.40486 11.2899 7.47633 17.5322
  10.7203 11.9356 9.76152 9.30846 26.6367 11.8641 18.5761 15.7852
  6.0273 13.084 14.2488 14.1349 20.4315 26.9903 19.4544 18.804
  16.8563 18.362 10.1395 18.812 24.282 33.2353 20.3219 32.5691
  28.7122 7.79271 11.1581 17.3146 16.3072 11.7142 13.3719 24.9269
  33.4572 14.6539
tline 2
legend SHR-SR
```

## 4.5 The x command

The x command is used to define the x-coordinates. A x command is required for every series in a chart. However, the actual x coordinates may be omitted (i.e. the x command consists of only the letter x). In this case the x-values

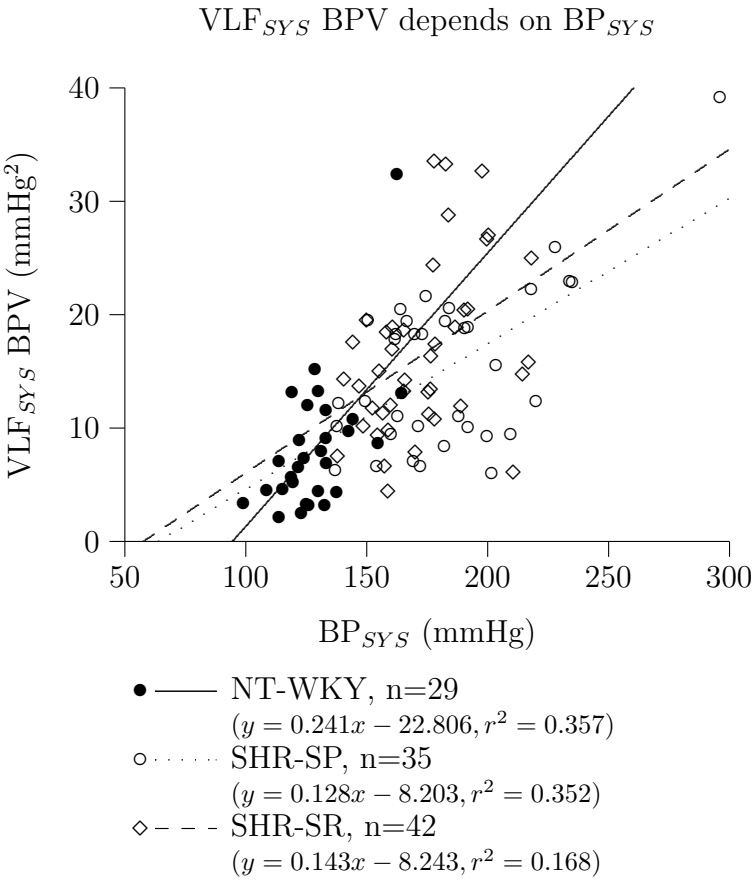


Figure 4.6: A complex example with regression lines. The legend was moved from the right side of the figure to the bottom by editing the LaTeX file of the diagram.

are assumed to start at 1 and increase by steps of 1. For example, consider the following graph that is composed of bar, line, and xy series (Fig. 4.7):

```
size 9 5
type bar
x
y    105 155 115 85
dy   10  12  9   8
type bar
x
y    165 210 150 130
dy   17  20  18  12
type bar
x
y    120 175 135 95
dy   12  16  11  8
type line
x
y    200 250 180 160
dy   13  16  9   8
type xy
x
y    200 250 180 160
```

The bars and lines of the resulting graph (Fig. 4.7) have their x-coordinates at 1, 2, 3, and 4. These x-coordinates are automatically defined by FASTPICTEX.

## 4.6 The xticlabels command

The xticlabels command allows to define labels for the tics at the x-axis. Examples are given in Fig. 4.8 that were created by the FASTPICTEX commands:

```
size 10 4
type bar
x
y    12  23  45  32
dy   1.2 2.5 5.3 4.8
type bar
x
y    65  34  12  85
```

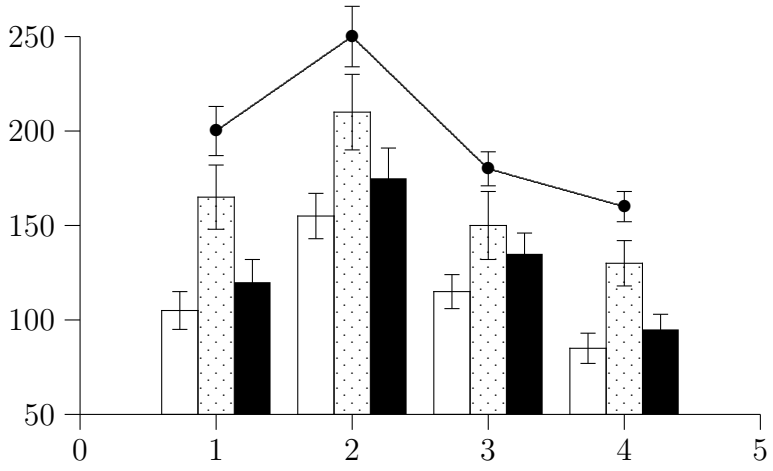


Figure 4.7: An example without x-coordinates.

```
dy   6.5 5.3 2.1 9.6
xticlabels Germany "Un. Kingd." Sweden France
```

and

```
size 10 4
type xy
x
y    12  54  34  42
dy   1.3 6.3 2.6 3.8
type line
x
y    12 54 34 42
xticlabels 1990 1992 1994 1996
```

If the labels contain blanks, you may enclose the entire label in quotes as demonstrated in on of the examples. One limitation is that it is not possible to use LaTeX formatting commands such as `\bf` or `\it` in xticlabels.

## 4.7 The y command

The y command is used to define the y-coordinates. This command is required for every series in a graph. It is possible to add a string (enclosed in

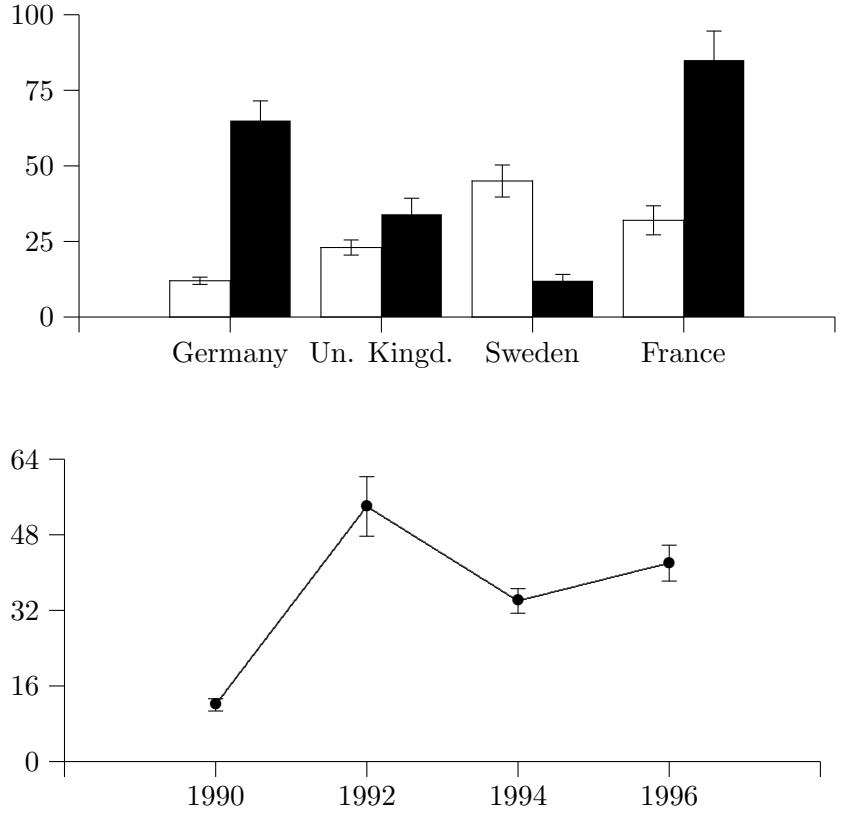


Figure 4.8: Examples with labels at the tics of the x-axis.

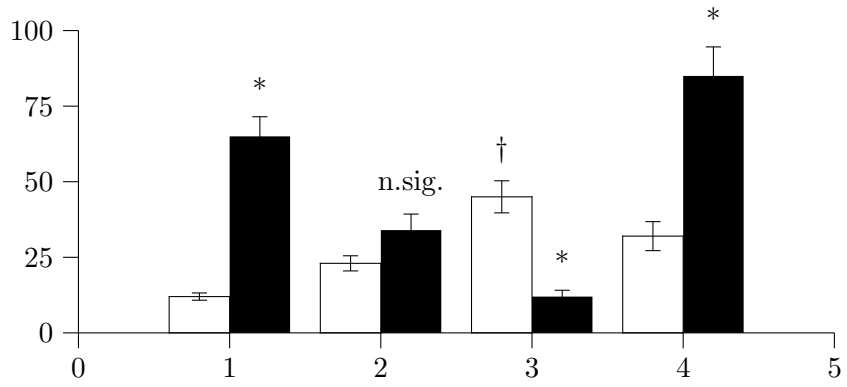


Figure 4.9: An example giving extra information on data points.

doublequotes) directly (without any whitespace) after the numbers for the y-values. This string will be printed on top of the data point in the chart. This feature allows to add asterisks to indicate that this data point is significant or to add other kind of information to a specific data point. Examples are given in Fig. 3.1, 4.9, and 4.13. The latter one was produced by the following FAST PICTEX commands:

```
size 10 4
type bar
x
y    12    23         45"$\dag$" 32
dy   1.2   2.5        5.3        4.8
type bar
x
y    65"*" 34"n.sig." 12"*"      85"*"
dy   6.5   5.3        2.1        9.6
```

## 4.8 The dx command

The dx command can be used to define error bars in x-direction. For example, if the standard errors are given, FAST PICTEX draws horizontal error bars extending to the left and to the right by ± the standard errors. An example is given in Fig. 4.3.

## 4.9 The dy command

The dy command can be used to define error bars in y-direction. For example, if the standard errors are given, FASTPICTEX draws vertical error bars extending up- and downwards by ± the standard errors. Examples are given in Figs. 3.1, 4.3, and 4.7.

## 4.10 The heading command

The heading command can be used to define a heading for a chart. The heading is placed above the chart. Standard LATEX formatting commands can be used as illustrated in the example given in Fig. 4.10.

```
% FastPicTeX input file
% 3 line graphs and 3 x-y graphs
heading \bf A chart plotted with \FastPiCTeX
type line
x 1 2 3 4 5 6 7 8 9 10
y 89 94 103 120 150 180 176 187 167 178
dy 9 11 13 8 14 9 12 11 10 13
type line
x 1 2 3 4 5 6 7 8 9 10
y 69 74 83 100 130 160 156 167 147 158
dy 9 11 13 8 14 9 12 11 10 13
type line
x 1 2 3 4 5 6 7 8 9 10
y 49 54 63 80 110 140 136 147 127 138
dy 9 11 13 8 14 9 12 11 10 13
type xy
x 1 2 3 4 5 6 7 8 9 10
y 89 94 103 120 150 180 176 187 167 178
type xy
x 1 2 3 4 5 6 7 8 9 10
y 69 74 83 100 130 160 156 167 147 158
type xy
x 1 2 3 4 5 6 7 8 9 10
y 49 54 63 80 110 140 136 147 127 138
```

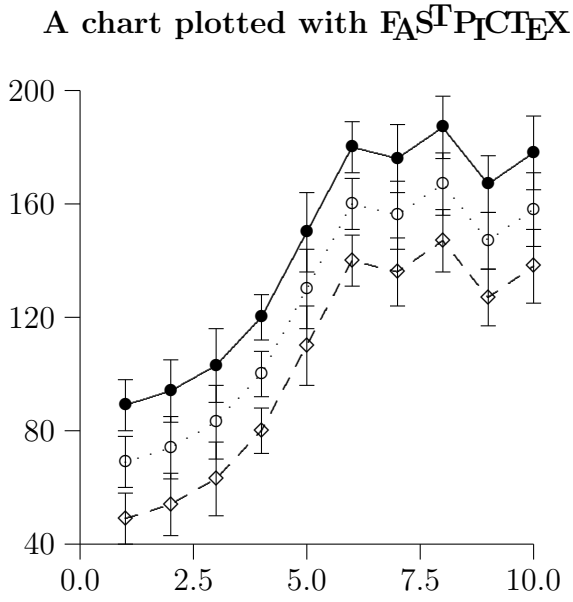


Figure 4.10: A chart with a heading.

## 4.11 The xlabel and ylabel commands

These two commands can be used to enter a label to the x- and y-axis. Like in the heading command, regular LaTeX formatting instructions can be included. If the y-axis label should be rotated by 90°, the command "`\rotatebox{}{}`" can be used. This command is included in the graphics package distributed with most TeX and LaTeX distributions. However, the "`\rotatebox{}{}`" command uses special commands that can only be handeled by some DVI-drivers, such as the DVIPS driver. Another alternative is the rotating package that offers the `\begin{sideways} ... \end{sideways}` environment that has been used to generate Fig. 4.6. An example using the "`\stack{}`" command to write the y-axis label vertically is shown in the next Figure (Fig. 4.11).

```
heading \bf Blood Pressure With Increasing Age
xlabel  time (years)
ylabel  \stack{b,l,o,o,d, , ,p,r,e,s,s,u,r,e}
type    line
x       25  30  35  40  45  50  60     70     80     90
y       120 135 156 165 175 190 203"*" 196"*" 210"*" 203"*"
dy      12  13  15  16  17  19  20  20  21  18
type    xy
```

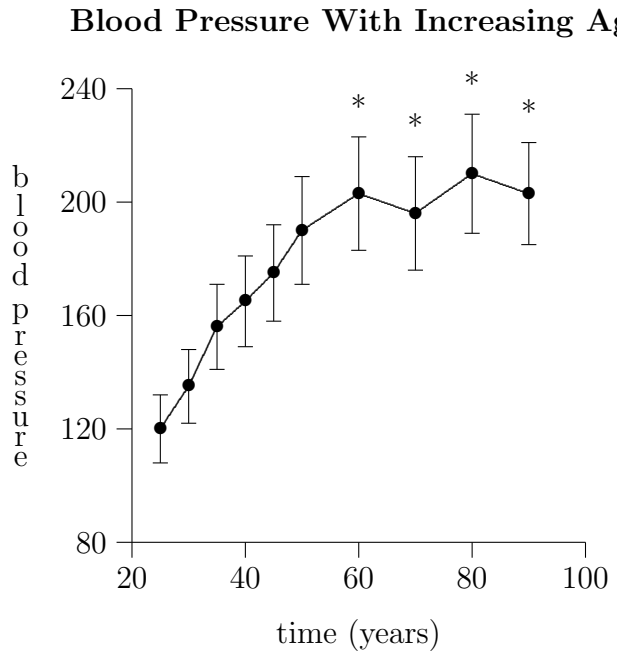


Figure 4.11: A chart with a heading and labels at the axis.

```
x       25  30  35  40  45  50  60  70  80  90
y       120 135 156 165 175 190 203 196 210 203
```

## 4.12 The xgrid and ygrid commands

If these commands are given, gridlines will be drawn in the x or y direction respectively. The commands do not need any parameters. If the xgrid or ygrid commands are not given, no gridlines will be drawn. An example is given in Fig. 4.12 that was generated by the following commands:

```
type    xy
heading A graph with grid lines
xgrid
x       123 234 196 349 453 98   294
dx      12  34  23  32  12  7.5  11.2
ygrid
y       12  65  84  47  23  91   17
dy      1.4 4.6 7.3 6.2 4.1 11.6 7.5
```

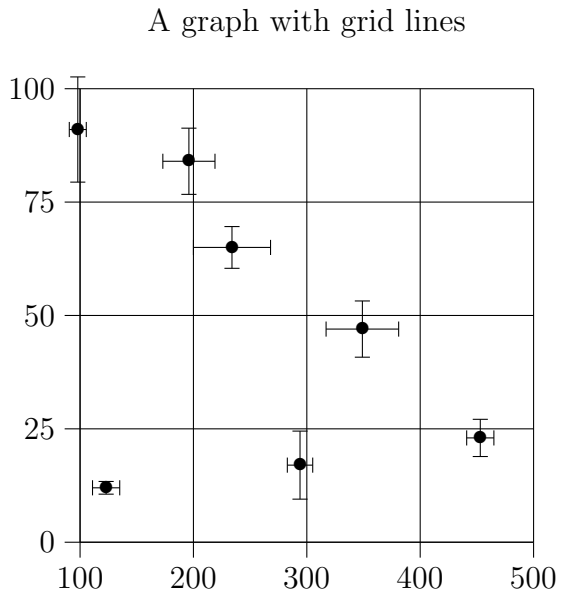


Figure 4.12: A chart with grid lines.

## 4.13 The legend command

If several series of data are plotted in one single diagram, one need to know which series represents which data. To add a legend to a series simply use: "`legend description of data series`". An example is given in Fig. 4.13 that was generated by the following FASTPICTEX file:

```
% Example for using legends
size 6.5 6
heading \bf VLF blood pressure variability
xlabel Weeks on high-salt diet
ylabel mmHg$^2$
% SHR-SP
legend SHR-SP, n=34
type bar
xticlabels 3-5 6-7
x 1 2
y  14.317 16.040
dy 1.549 1.942
% SHR-SR
legend SHR-SR, n=37
type bar
x 1 2
```

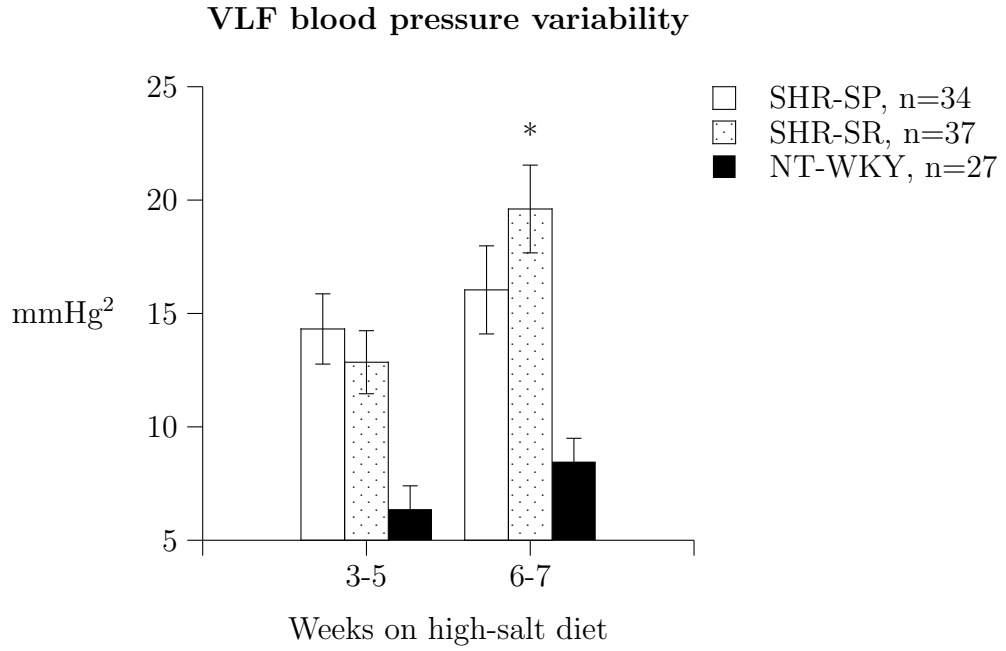


Figure 4.13: An example with legends.

```
y  12.850  19.608"*"
dy 1.390   1.935
% NT-WKY
legend NT-WKY, n=27
type bar
x 1 2
y  6.374 8.466
dy 1.026 1.031
```

## 4.14 The pictex command

Text following the pictex command is simply copied into the pictex file to be interpreted by PICTEX. This command allows adding plain PICTEX instructions to FASTPICTEX files. The syntax for this command is not very complicate: "`pictex whatever you want to pass on to pictex`". An example is provided in Fig. 4.14 that was generated by the following FASTPICTEX code:

```
% example showing the use of pictex commands
size 5 3
```

```
heading Blood pressure on 5 consecutive days
xlabel Days
ylabel mmHg
% xy graph for male subjects
type xy
xticlabels 1 2 3 4 5
x  1 2 3 4 5
y  105 96 150 87 98
dy 10 9 13 5 7
legend male subjects, n=9
% xy graph for female subjects
type xy
x  1 2 3 4 5
y  85 92 80 95 90
dy 7 8 9 10 7
legend female subjects, n=7
% line graph for male subjects
type line
x  1 2 3 4 5
y  105 96 150 87 98
% line graph for female subjects
type line
x  1 2 3 4 5
y  85 92 80 95 90
% here are the pictex commands
pictex \arrow <3mm> [0.2,0.67] from 3.5 160 to 3.1 150
pictex \put {artifact} [lc] at 3.6 160
```

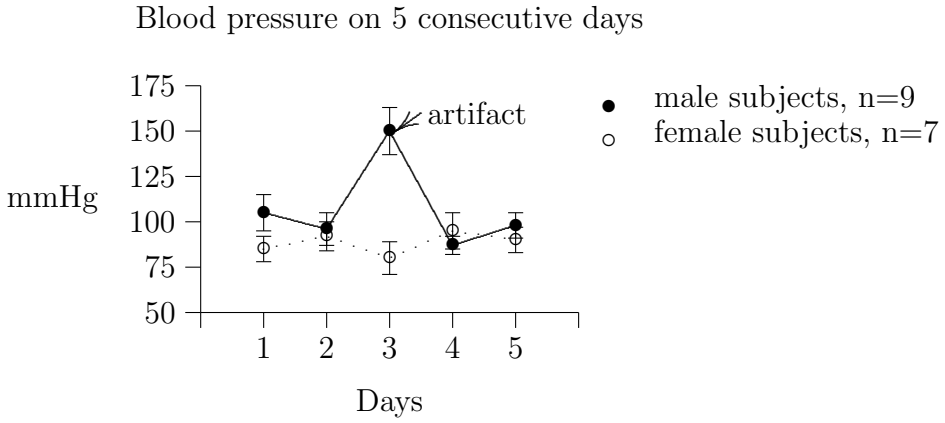


Figure 4.14: PICTEX commands included in FASTPICTEX.

# Bibliography

[1] Donald E. Knuth. *The TEXbook*. Addison-Wesley Co., Inc., 1991.

[2] Leslie Lamport. *LATEX a document preparation system*. Addison-Wesley Co., Inc., 1985.

[3] Michael J. Wichura. *The PICTEX Manual*. TEX Users Group, 1987.