pst-lsystem

Creating images, based on the Lindenmayer-system; v.0.02

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Contents

Abstract

pst-lsystem loads by default the following packages: pst-xkey, and, of course pstricks. All should be already part of your local TEX installation. If not, or in case of having older versions, go to http://www.CTAN.org/ and load the newest version.

Thanks to
Michel Charpentier, and last but not least http://mathworld.wolfram.com.

1 Introduction

A L-system or Lindenmayer system is a parallel rewriting system and a type of formal grammar. An L-system consists of an alphabet of symbols that can be used to make strings, a collection of production rules that expand each symbol into some larger string of symbols, an initial »axiom« string from which to begin construction, and a mechanism for translating the generated strings into geometric structures. L-systems were introduced and developed in 1968 by Aristid Lindenmayer, a Hungarian theoretical biologist and botanist at the University of Utrecht. [10]

2 Usage

There are no optional arguments for the package:

```
\usepackage{pst-lsystem}
```

There is only one command:

`\pslsystem[Options](x,y)`

If the coordinates for the origin are missing, then $(0,0)$ is assumed. The L-System ist defined by the three functions F, X, and Y. At least one function must be given.

2.1 Optional arguments

The following optional arguments for the macro are possible:

name	*default*	*menaing*
`F`		Rule $F \to (F)$
`X`		Rule $X \to (F,X,Y)$
`Y`		Rule $Y \to (F,X,Y)$
`Start`		Startrule $S \to (F,X,Y)$
`Angle`	45	Angle for the drection change
`N`	5	Number of the recursive calls
`Ftype`	4	How the F-rule should be handled
`BaseLength`	1mm	The length of a base line, created by the ruke F (Forward)
`usecolor`	0	Which color should be used for the lines.

If the rules contain square brackets then it must be enclosed by braces: `X=F[-X]` is wrong and `X={F[-X]}` is correct.

2.2 Different types for the F-rule

It depends to the given rule(s) what kind of the F-type must be used. There are five possibilities:

`0` $F \to$ draw line element
in PostScript: `/F { D } def`

`1` $F \to$ If loop variable $= 0$ then draw line element
in PostScript: `/F { 0 eq { D } if } def`

`2` $F \to$ If loop variable $= 0$ then draw line element and keep variable

in PostScript: `/F { dup 0 eq { D } if } def`

3 $F \rightarrow$ draw line element and delete current loop variable
in PostScript: `/F { pop D } def`

4 $F \rightarrow$ If loop variable $= 0$ then draw line element! If not $= 0$ decrease loop variable, duplicate it $n - 1$ times (n is the number of functions in F) and put F-rule on stack
in PostScript: `/F { dup 0 eq { D }{ 1 sub N 1 sub {dup} repeat F-rule } ifelse pop } def`

The function D does nothing else than drawing a line in the current direction. Its length is given by the optional parameter BaseLength.

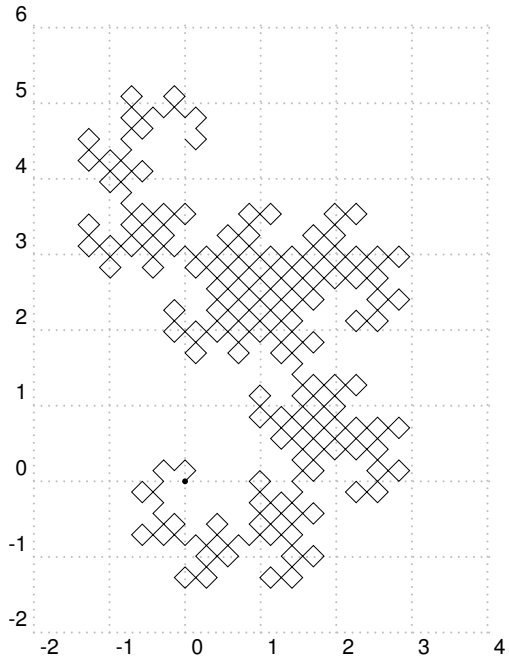
2.3 Color

There are four predefined color modes, where mode=0 is no color.

3 Examples

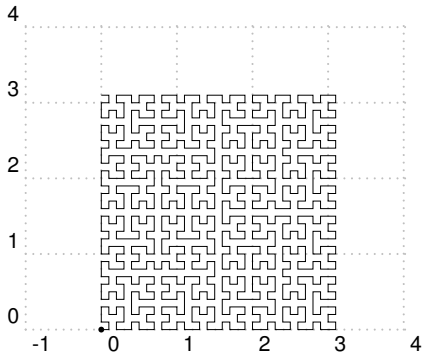
3.1 Dragon

```
\begin{pspicture}[showgrid=true](-2,-1.5)(4,6)
\pslsystem[
  X=-FX++FY-,
  Y=+FX--FY+,
  Ftype=1,
  Start=X,
  Angle=45,
  N=9,
  BaseLength=2mm](0,0)
\psdot(0,0)
\end{pspicture}
```



3.2 Hilbert

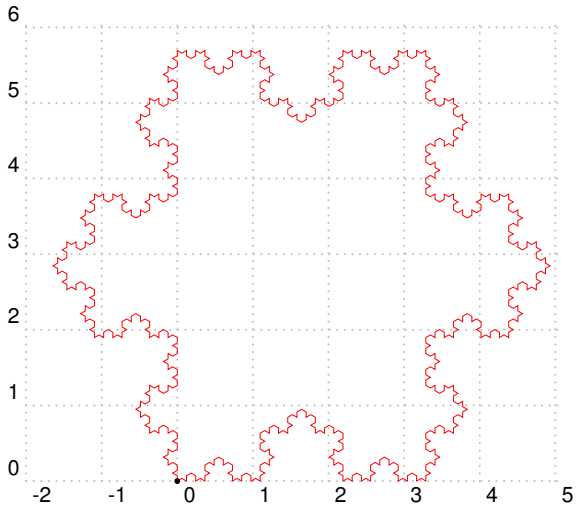
```
\begin{pspicture}[showgrid=true](-1,-0.5)(4,4)
\pslsystem[
  X=-YF+XFX+FY-,
  Y=+XF-YFY-FX+,
  Ftype=3,
  Start=X,
  Angle=90](0,0)
\psdot(0,0)
\end{pspicture}
```



3.3 Kochflake

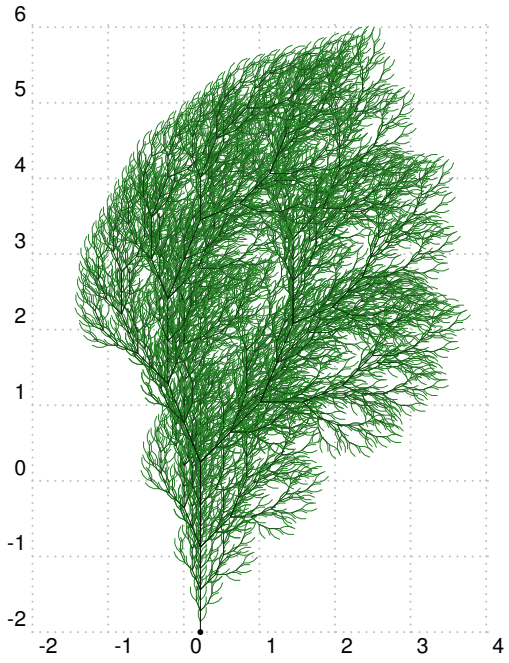
If the rule for `Start` has more than one function name, one has to repeat the number of iterations, which is `N`, before every following function, but not for the first one. That is done already internally:

```
\begin{pspicture}[showgrid=true](-2,-.5)(5,6)
\pslsystem[
  Start=F--NF--NF,% repeat number of iterations N
  F=F+F--F+F,
  Angle=60,
  N=4,
  BaseLength=2pt,
  linecolor=red](0,0)
\psdot(0,0)
\end{pspicture}
```



3.4 Plant 1

```
\begin{pspicture}[showgrid=true](-2,-2.3)(4,6)
\pslsystem[
  Start=F,
  F={FF-[-F+F+F]+[+F-F-F]},
  Angle=22.5,
  BaseLength=2pt,
  usecolor=4](0,-2)
\psdot(0,-2)
\end{pspicture}
```

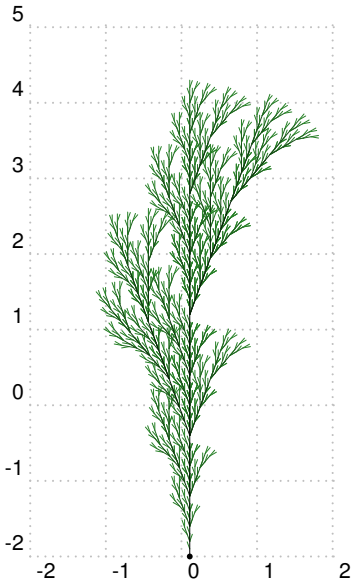


3.5 Plant 2

```
\begin{pspicture}[showgrid=true](-3,-2.3)(2,6)
\pslsystem[
  Start=X,
  X={F-[[X]+X]+F[+FX]-X},
  F=FF,
  Angle=22.5,
  N=6,
  BaseLength=1.25pt,
  usecolor=3](0,-2)
\psdot(0,-2)
\end{pspicture}
```

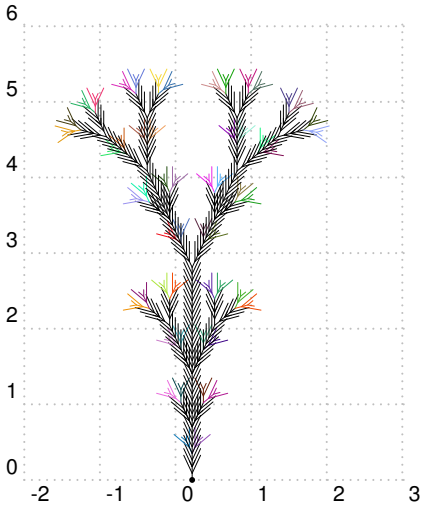
3.6 Plant 3

```
\begin{pspicture}[showgrid=true](-2,-2.5)(2,5)
\psset{xunit=3}
\pslsystem[
  Start=F,
  F={F[+F]F[-F][F]},
  Angle=20,
  usecolor=3](0,-2)
\psdot(0,-2)
\end{pspicture}
```



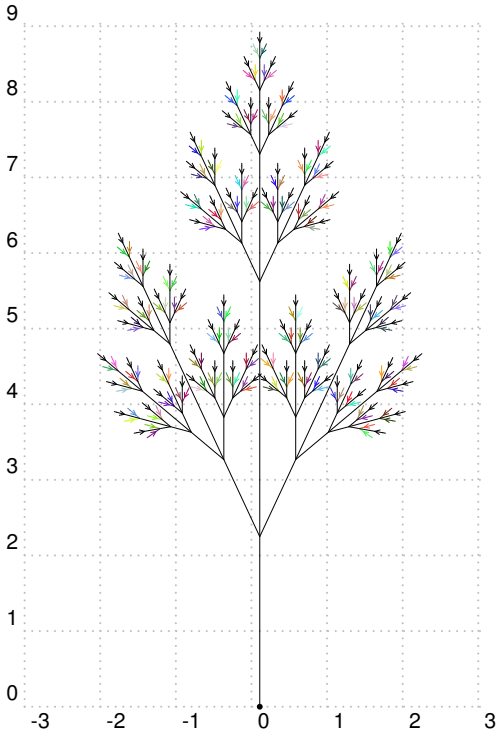
3.7 Plant 4

```
\begin{pspicture}[showgrid=true](-2,-0.5)(3,6)
\pslsystem[
  Start=Y,
  X={X[-FFF][+FFF]FX},
  Y={YFX[+Y][-Y]},
  Angle=25,
  N=6,
  Ftype=1,
  BaseLength=2.5pt,
  usecolor=2](0,0)
\psdot(0,0)
\end{pspicture}
```



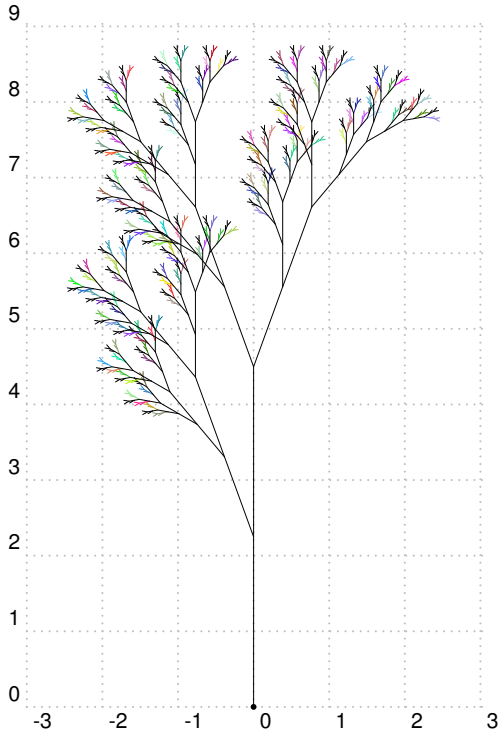
3.8 Plant 5

```
\begin{pspicture}[showgrid=true](-3,-.5)(3,9)
\pslsystem[
  Start=X,
  X={F[+X][-X]FX},
  F={FF},
  Angle=25,
  N=7,
  BaseLength=1pt,
  usecolor=2](0,0)
\psdot(0,0)
\end{pspicture}
```



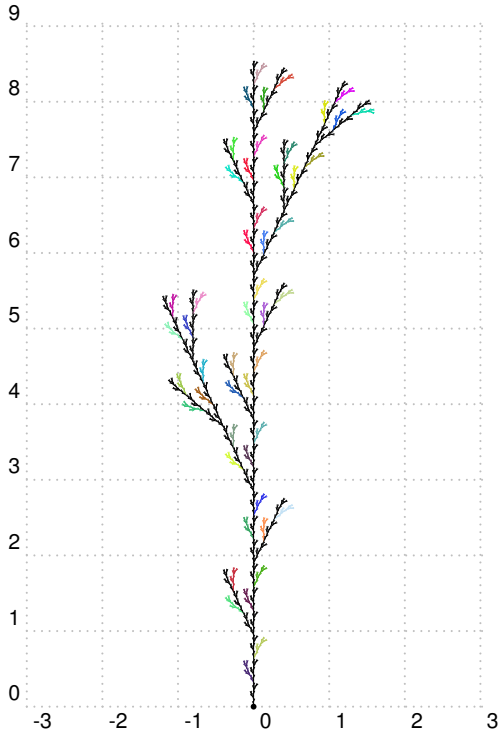
3.9 Plant 6

```
\begin{pspicture}[showgrid=true](-3,-.5)(3,9)
\pslsystem[
  Start=X,
  X={F[+X]F[-X]+X},
  F={FF},
  Angle=20,
  N=7,
  BaseLength=1pt,
  usecolor=2](0,0)
\psdot(0,0)
\end{pspicture}
```



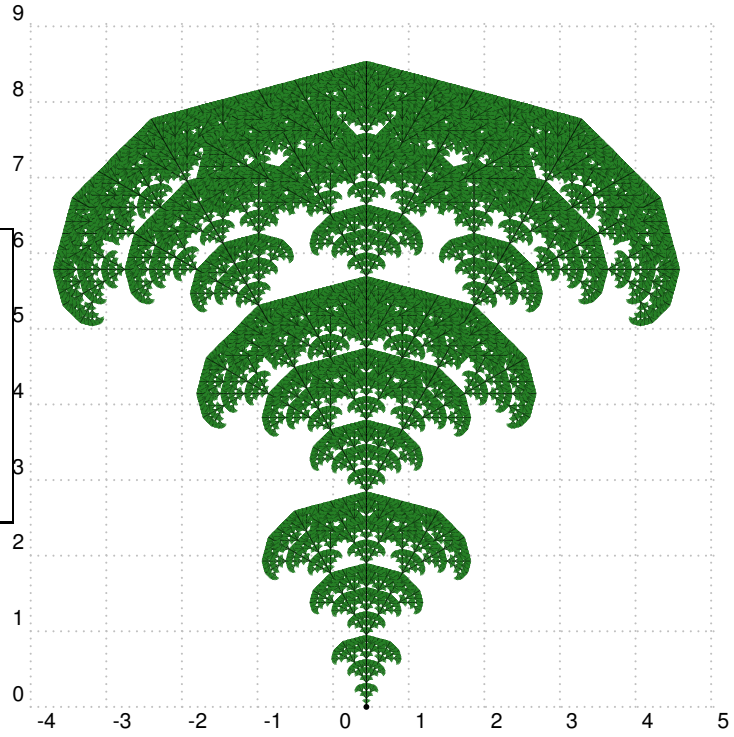
3.10 Plant 7

```
\begin{pspicture}[showgrid=true](-3,-.5)(3,9)
\pslsystem[
  Start=F,
  F={F[+F]F[-F]F},
  Angle=25,
  BaseLength=1pt,
  usecolor=2](0,0)
\psdot(0,0)
\end{pspicture}
```



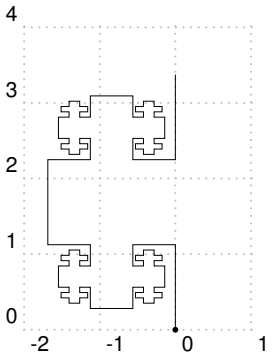
3.11 Plant 8

```
\begin{pspicture}[showgrid=true](-4,-.5)(5,9)
\pslsystem[
  Start=F,
  F={F[+F[+F][-F]F][-F[+F][-F]F]F[+F][-F]F},
  Angle=30,
  BaseLength=1pt,
  usecolor=4](0,0)
\psdot(0,0)
\end{pspicture}
```



3.12 Special case

```
\begin{pspicture}[showgrid=true](-2,-0.5)(1,4)
\pslsystem[
  Start=X,
  F=FF,
  X=F+X-F-X+F,
  Angle=90,
  N=6,
  BaseLength=1pt](0,0)
\psdot(0,0)
\end{pspicture}
```



4 List of all optional arguments for pst-lsystem

Key	Type	Default
F	ordinary	
X	ordinary	
Y	ordinary	
Start	ordinary	
Angle	ordinary	45
N	ordinary	5
Ftype	ordinary	4
N2	ordinary	4
BaseLength	ordinary	1mm
usecolor	ordinary	0
order	ordinary	5

References

[1] Michel Charpentier. *Dragon Curve in PostScript*. URL: http://www.cs.unh.edu/~charpov/Programming/L-systems/simple-dragon.ps (visited on 09/24/2018).

[2] Michel Charpentier. *L-systems in PostScript*. URL: http://www.cs.unh.edu/~charpov/Programming/L-systems/plant2.ps (visited on 09/24/2018).

[3] Michel Charpentier. "Programming L-Systems in PostScript". In: *Zpravodaj Československého sdružení uživatelů TEXu* 1 (2012), pp. 9–19. DOI: 10.5300/2012-1/9. URL: http://bulletin.cstug.cz/pdf/bul_0013.pdf (visited on 09/25/2018).

[4] Michel Goosens et al. *The LaTeX Graphics Companion*. 2nd ed. Reading, Mass. (USA): Addison-Wesley Publishing Company, 2007.

[5] Nikolai G. Kollock. *PostScript richtig eingesetzt: vom Konzept zum praktischen Einsatz*. Vaterstetten: IWT, 1989.

[6] Przemyslaw Prusinkiewicz and Aristid Lindenmayer. *The Algorithmic Beauty of Plants*. Springer-Verlag, 1990.

[7] Herbert Voß. *PSTricks – Grafik für TEX und LaTeX*. 7th ed. Heidelberg and Berlin: DANTE and Lehmanns Media, 2017.

[8] Herbert Voß. *PSTricks – Graphics and PostScript for LaTeX*. 1st ed. Cambridge – UK: UIT, 2011.

[9] Herbert Voß. *LaTeX Referenz*. 3rd ed. Heidelberg and Berlin: DANTE and Lehmanns Media, 2012.

[10] WikipediA. *L-system*. Sept. 8, 2018. URL: https://en.wikipedia.org/wiki/L-system (visited on 09/22/2018).

[11] Timothy van Zandt. *PSTricks - PostScript macros for generic TEX*. 1993. URL: http://www.tug.org/application/PSTricks.

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