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
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 is 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:

<table>
<thead>
<tr>
<th>name</th>
<th>default</th>
<th>meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>( F )</td>
<td>Rule ( F \rightarrow (F) )</td>
<td></td>
</tr>
<tr>
<td>( X )</td>
<td>Rule ( X \rightarrow (F, X, Y) )</td>
<td></td>
</tr>
<tr>
<td>( Y )</td>
<td>Rule ( Y \rightarrow (F, X, Y) )</td>
<td></td>
</tr>
<tr>
<td>Start</td>
<td>Starrule ( S \rightarrow (F, X, Y) )</td>
<td></td>
</tr>
<tr>
<td>Angle</td>
<td>45</td>
<td>Angle for the direction change</td>
</tr>
<tr>
<td>N</td>
<td>5</td>
<td>Number of the recursive calls</td>
</tr>
<tr>
<td>Ftype</td>
<td>4</td>
<td>How the F-rule should be handled</td>
</tr>
<tr>
<td>BaseLength</td>
<td>1mm</td>
<td>The length of a base line, created by the rule ( F ) (Forward)</td>
</tr>
<tr>
<td>usecolor</td>
<td>0</td>
<td>Which color should be used for the lines.</td>
</tr>
</tbody>
</table>

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

0 \( F \rightarrow \) draw line element
   \hspace{1em} in PostScript: \( /F \{ D \} \) def
1 \( F \rightarrow \) If loop variable = 0 then draw line element
   \hspace{1em} in PostScript: \( /F \{ 0 \text{ eq} \{ D \} \text{ if} \} \) def
2 \( F \rightarrow \) If loop variable = 0 then draw line element and keep variable
3 Examples

in PostScript: \( F \{ \text{dup 0 eq \{ D \} if } \} \text{ def} \)

\( F \rightarrow \) draw line element and delete current loop variable

in PostScript: \( F \{ \text{pop D } \} \text{ def} \)

\( F \rightarrow \) 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: \( F \{ \text{dup 0 eq \{ D \} \{ 1 \text{ sub } N \text{ 1 sub \{dup\} repeat F-rule } \} \text{ ifelse pop } \} \text{ def} \)

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+XF+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{unit=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,
    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 \texttt{pst-lsystem}

<table>
<thead>
<tr>
<th>Key</th>
<th>Type</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>ordinary</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>ordinary</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>ordinary</td>
<td></td>
</tr>
<tr>
<td>Start</td>
<td>ordinary</td>
<td></td>
</tr>
<tr>
<td>Angle</td>
<td>ordinary</td>
<td>45</td>
</tr>
<tr>
<td>N</td>
<td>ordinary</td>
<td>5</td>
</tr>
<tr>
<td>Ftype</td>
<td>ordinary</td>
<td>4</td>
</tr>
<tr>
<td>N2</td>
<td>ordinary</td>
<td>4</td>
</tr>
<tr>
<td>BaseLength</td>
<td>ordinary</td>
<td>1mm</td>
</tr>
<tr>
<td>usecolor</td>
<td>ordinary</td>
<td>0</td>
</tr>
<tr>
<td>order</td>
<td>ordinary</td>
<td>5</td>
</tr>
</tbody>
</table>

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