Exploring the road map with the program logistic.exe

Wolf Jung
Inst. f. Reine u. Angew. Mathematatik, RWTH Aachen
Templergraben 55, D-52062 Aachen, Germany
jung@iram.rwth-aachen.de

July 30, 1998.

Abstract

We consider the real iteration of $f_c(z) = z^2 + c$.
The DOS-program logistic.exe is available from
http://www.iram.rwth-aachen.de/~jung .

References

[1] L. Carleson and T. Gamelin, *Complex Dynamics*, Springer, New York 1993.

[2] R. L. Devaney, *An Introduction to Chaotic Dynamical Systems*, Benjamin, Menlo Park 1986.

[3] J. H. Hubbard, Dierk Schleicher, The Spider Algorithm, in: *Complex Dynamical Systems: The Mathematics behind the Mandelbrot and Julia Sets*, R. L. Devaney ed., Proc. symp. appl. math. **49**, AMS 1994.

[4] R. D. Neidinger, R. J. Annen III, The Road to Chaos is filled with Polynomial Curves, Am. Math. Monthly **103**, 640–653 (1996).

Common commands for the road map and the graph of f_c	
4, 6	small shift of the cursor
$\leftarrow$, $\rightarrow$	big shift
+, –	create a frame and enlarge it, reduce the frame or remove it
ENTER	magnify the content of the frame, or redraw the image
BACKSPACE	return to the previous larger image
HOME	restart with the road map / the graph of f_c^1
F1	get a list of all available commands
F2	change between the road map and the graph
ESC, END	terminate the program
$*$	mark the current cross or frame
Special commands for the road map	
c	enter a new value for the parameter c
$>$, $<$, i	change the vertical size of the frame, get full vertical size
F3	turn the display of coordinates off or on (full-screen mode)
F4	change between full-screen mode and 4-window mode
q	draw the graph of $f_c^n(0)$
m	draw the graph of $f_c^{n+k}(0) + f_c^k(0)$
PAGE$\downarrow$	shift c to a zero of the last q/m-curve
0	shift c to the center for the current attracting period
d	shift c to the center for the adjacent double period
D	shift c to the center for the double period w.r.t. $c_F = -1.401155$
w	get the current window (use ENTER or $*$ afterwards)
b	extend the curves of an attracting cycle to the repelling region of parameter values c
Special commands for the graph of f_c	
z	enter a new value for the coordinate z
a, x	show the corresponding values of a and x for $x \mapsto ax(1-x)$
n	set the current order n of the iterates.
PAGE$\downarrow$	shift z to a fixed point of f_c^n, i.e. a n-periodic point of f_c
f, PAGE$\uparrow$	map $z \mapsto z^2 + c$ (with cobweb if $n = 1$)
F, CTRL PAGE$\uparrow$	map n times $z \mapsto z^2 + c$ (without cobweb)
l, r	inverse map: $z \mapsto \mp\sqrt{z-c}$
F4	draw a cobweb of 150 iterations of f_c (only for $n = 1$)