Introduction

Fraxious allows the generation of several different classes of fractal:

Mandelbrot Set
Julia Set
Newton’s Method
Henon
Strange Attractor
2–Dimensional Fractional Brownian Motion (FM2D)
Lyapunov

The pictures generated may be saved and loaded into other programs. In addition, Fraxious can produce Quicktime movies between two fractals of the same type, allowing zooming and variation of continuous parameters between frames.

Creation of a fractal involves choosing the New ***fractal type É*** menu item, changing the default parameters in the presented dialog box, and pressing OK.

Fraxious then generates the fractal in a window. The Colour Palette floating window allows the colours used to be changed.

When the fractal is saved, it is saved as a Macintosh PICT, with some additional resources. This means that it can be read by standard image-editing programs and word-processors.

Starting the Program

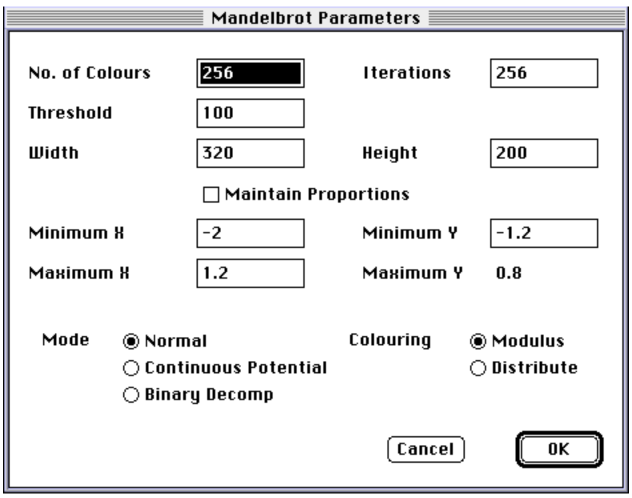
Double click on the Fraxious icon. Fraxious starts without any open windows. You must select New or Open É from the File menu to create a fractal or open an existing fractal.

The New Menu

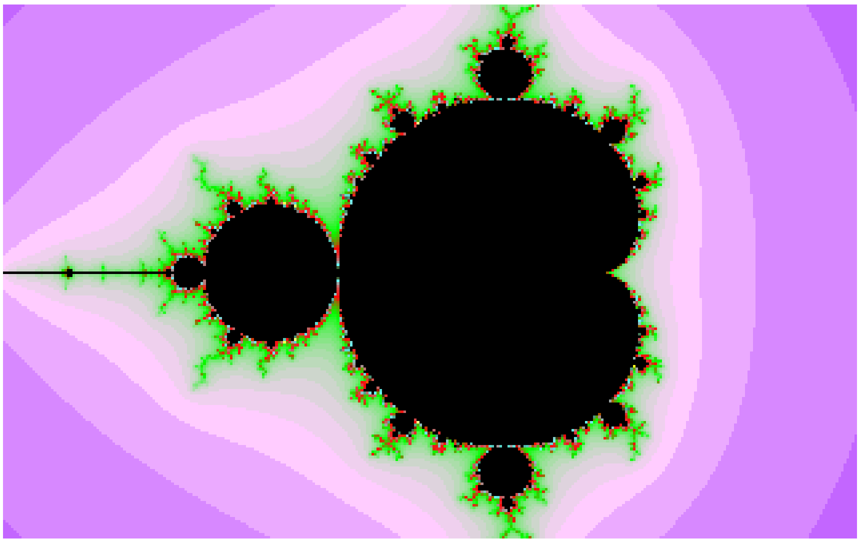
Choose one of the fractal types from this menu to create a fractal.

Simple Mandelbrot

This gives you the Mandelbrot Set for $z^2 + c$. The dialog box gives you a number of options for altering the final fractal:

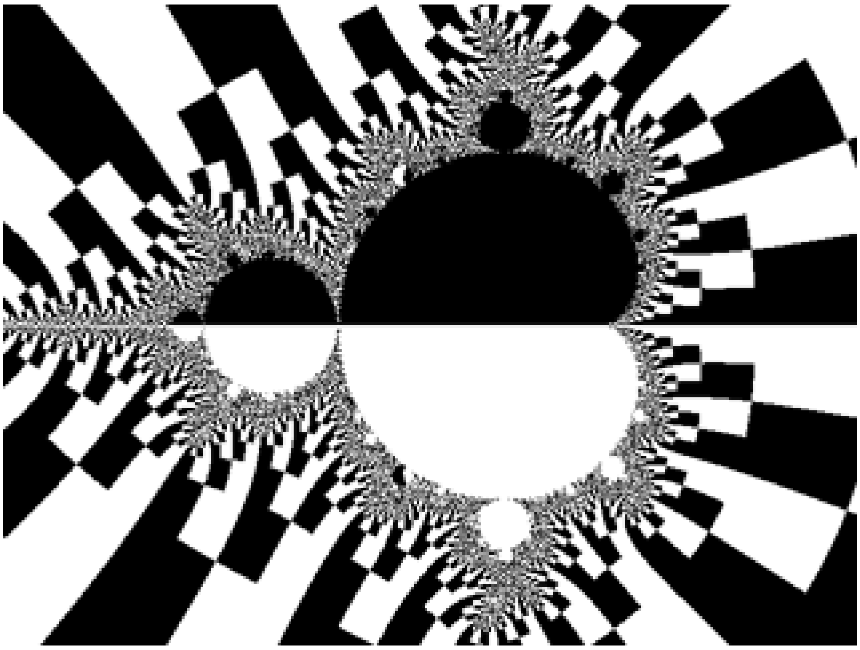


No. of Colours	The number of colours to be used in the picture.Choosing a number greater than 256 uses a lot of memory without much increase in picture quality.
Iterations	The maximum number of iterations to perform for each pixel. A higher figure gives a better detail fractal.
Threshold	If an iteration gives a result above this, it is assumed to have escaped to infinity. A higher value gives better detail.
Width, Height	Size of the fractal picture.
Minimum X, Minimum Y	The values on the complex plane corresponding to the top-left corner of the picture.
Maximum X, Maximum Y	The values on the complex plane corresponding to the bottom-right of the picture.
Mode: Normal	The normal mode of colouring — a pixel is assigned a colour number corresponding to how many iterations it took to escape to infinity:



Mode: Continuous Potential	Colouring by the continuous potential method:

Mode: Binary Decomposition	Colouring in black-and-white by binary decomposition method:

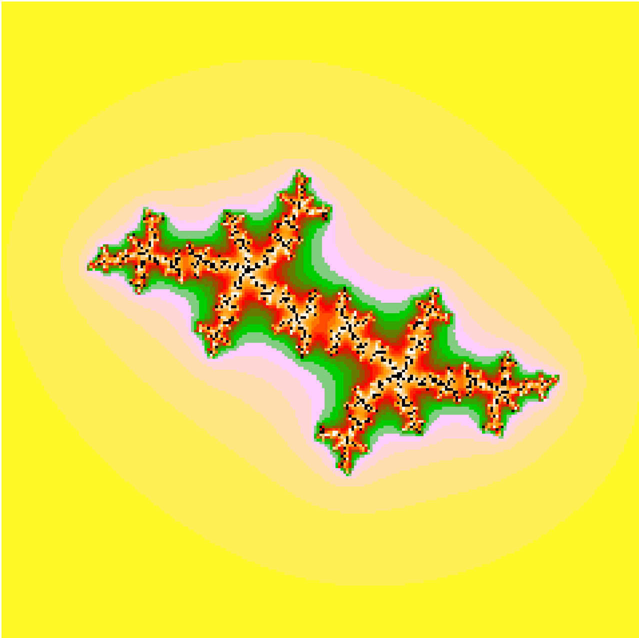


Colouring: Modulus	If the number of iterations is greater than the number of colours, the colours are reused from colour zero.
Colouring: Distribute	If the number of iterations is greater than the number of colours, the colours are distributed over the number of iterations.

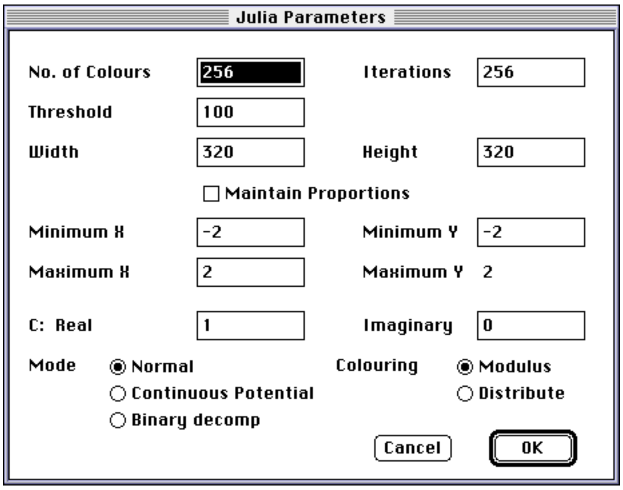
The Maintain Proportions Check Box, when checked, keeps Width and Height in proportion to each other.

Simple Julia

This generates the Julia Set for $z^2 + c$.



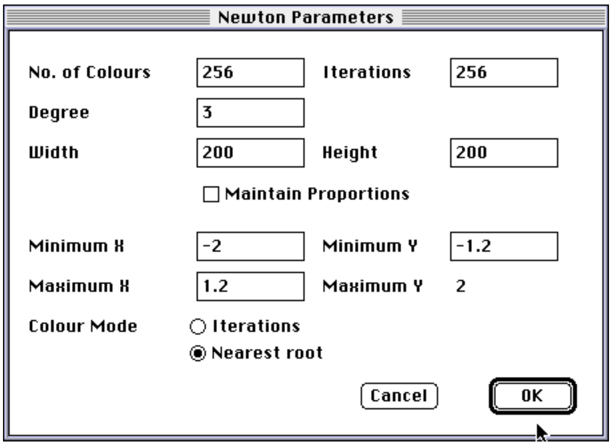
The parameters dialog box for this fractal is the same as for Simple Mandelbrot, with the addition of the Real and Imaginary fields for inclusion in the Julia iterations:



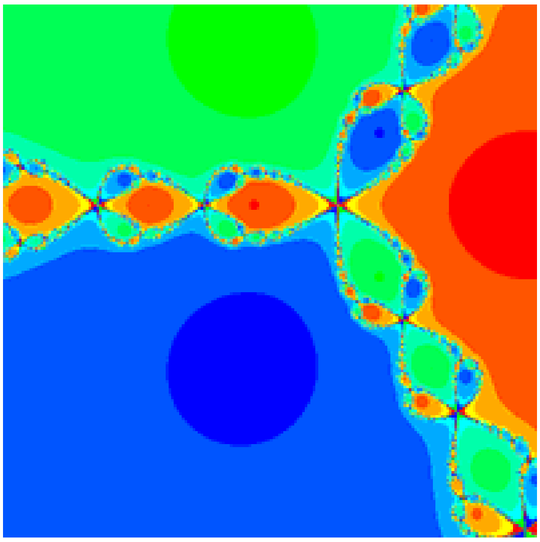
Simple Newton

Newton's method for finding roots for the equation $z^n - 1$.

Most of the fields in the parameters dialog box are the same as for Simple Mandelbrot. An additional field, Degree, is the degree of the polynomial (n in $Z^n - 1$).



Two methods of colouring are available: the Iterations method is the same as Mandelbrot and Julia; the Nearest Root method splits the palette into n sets, each corresponding to a root. Each pixel is coloured according to which root it converges to.



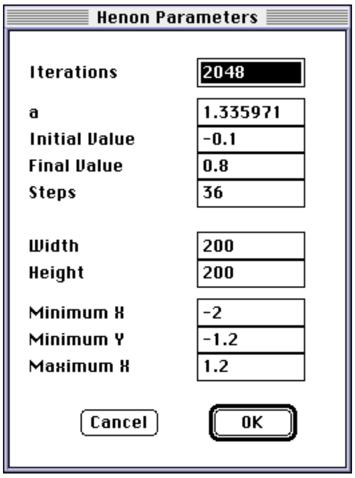
Henon

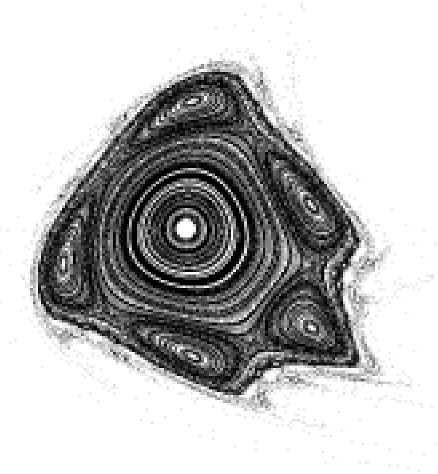
Generates a Henon map according to the equations:

$$x_{n+1} = x_n \times \cos(a) - (y_n - x_n^2) \times \sin(a)$$

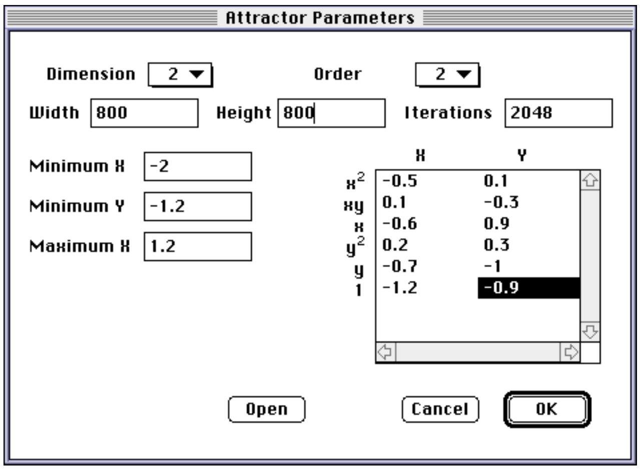
$$y_{n+1} = x_n \times \sin(a) + (y_n - x_n^2) \times \cos(a)$$

The initial values for *x* and *y* are determined from the initial value, final value, and number of steps on the Henon parameters dialog box:

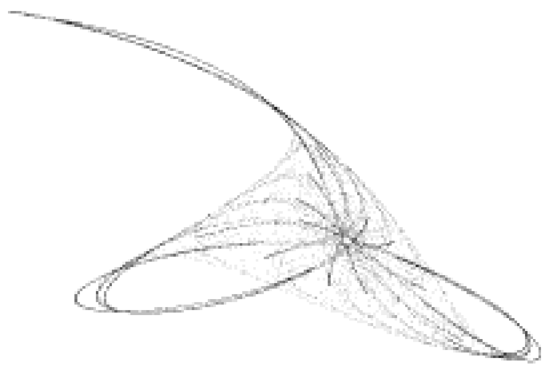




Strange Attractor

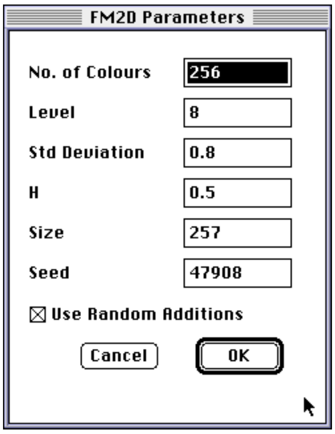


Dimension is the number of unknowns in the equation: for example a dimension of three gives unknowns *X*, *Y*, and *Z*. Order gives the highest power in the equation.The list box contains the coefficients of the terms for the equation. Select one and click on the **Open** button, or double-click on one, to bring up another dialog which allows you to change the coefficient.



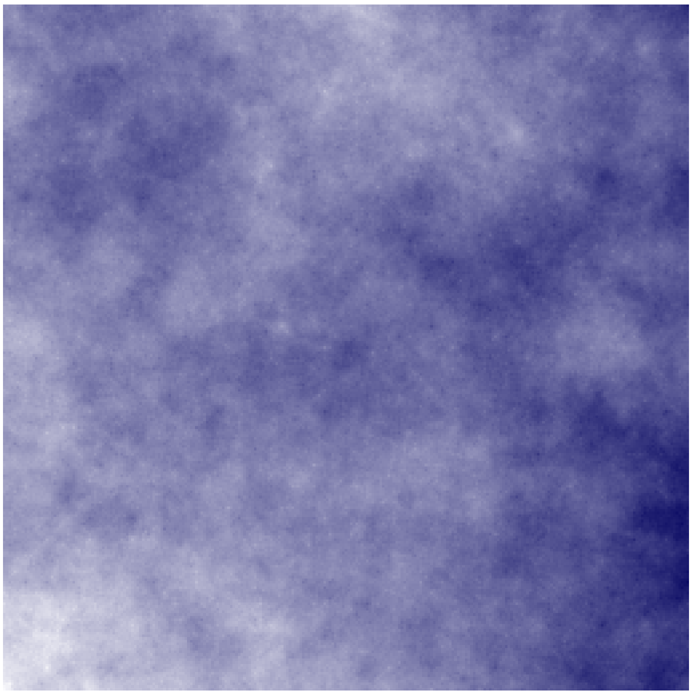
FM2D

In the parameters dialog box, **Level** is the number of iterations through the main loop. In general, a level of *n* will give a good FM2D size of $2^n + 1$; e.g. a level of 8 will give a good FM2D of 257 × 257. If you use a bigger **Size** than this, the picture will be stretched, and quality will be reduced.



H determines the fluffiness of the cloud. A low value (say 0.05) gives a fluffy cloud. A value of 1.0 gives a smooth cloud. **Seed** is the random number generator seed. If you keep all the other parameters the same, but change the seed, you get different clouds.

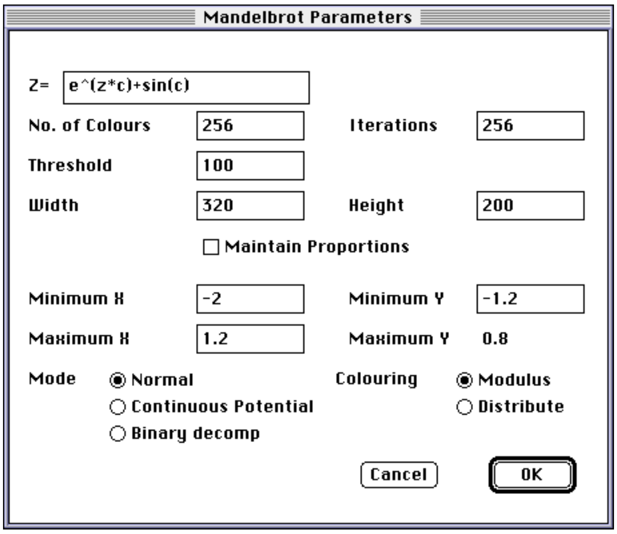
Checking **Random Additions** gets rid of some artificial ridge anomalies in the cloud.



General Mandelbrot

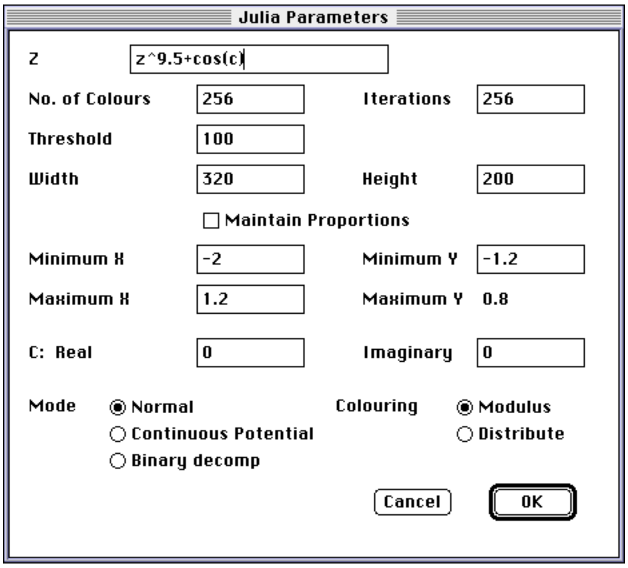
As for Simple Mandelbrot, but includes an additional field for specifying the right-hand-side of an equation instead of using $z_{n+1} = z_n + c$.

This allows fairly arbitrary equations to be built including the operators +, -, *, /, ^ (to the power of), brackets and nested brackets. The terms z, c, e, and π may be used, and also the functions real, imag, abs, norm, arg, conj, cos, cosh, exp, log, sin, sinh, sqrt, tan, tanh.



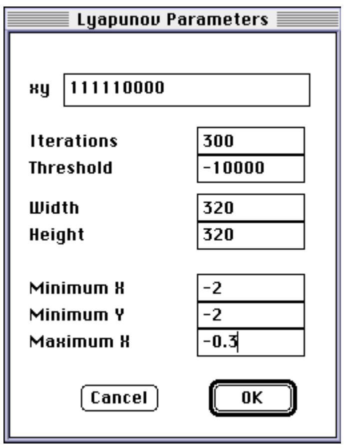
General Julia

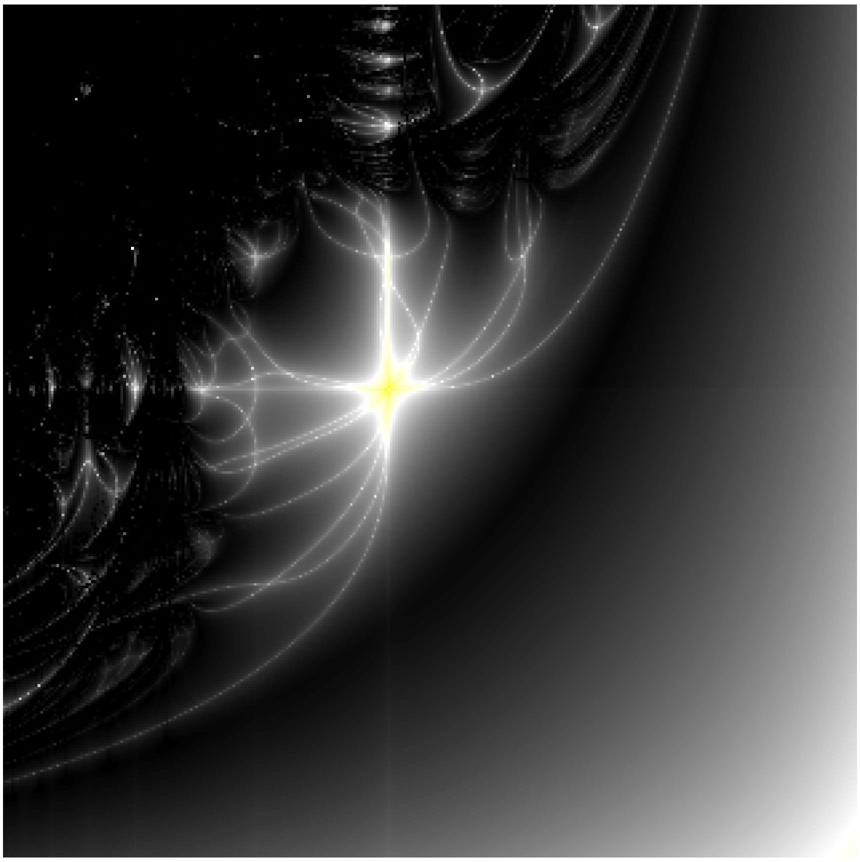
Like General Mandelbrot, General Julia is Simple Julia with an additional field for specifying the iteration equation.



Lyapunov

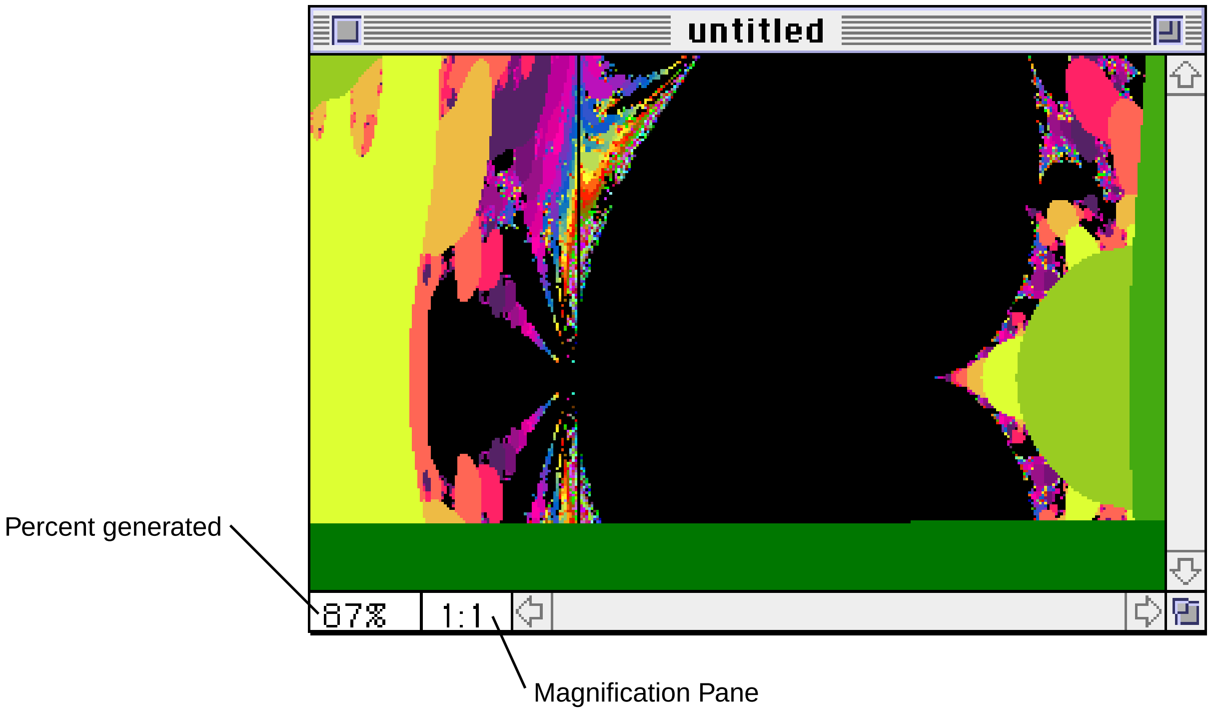
The xy edit field requires a string of ones and zeroes.Currently the threshold field is ignored.





The Document Window

The Document Window has the usual features of a Macintosh window, plus a couple of extra ones.



Note that the cursor turns to a crosshairs over the content region of the window. This means you can make a rectangular selection by dragging over part of the content region.The selection can be copied to the clipboard for pasting into another application, or used to generate another fractal, zooming in.

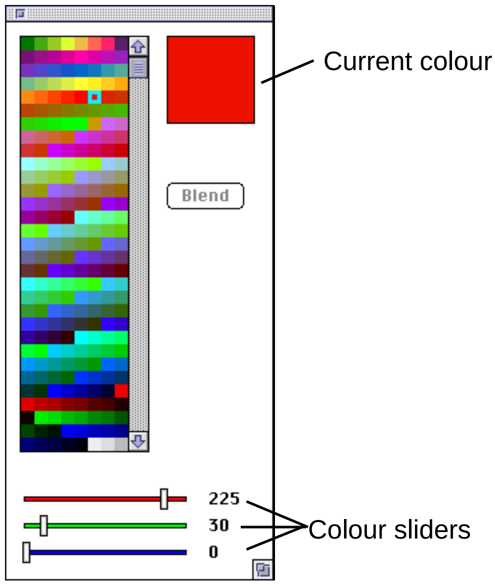
If you click on the Magnification Pane, the cursor changes to a magnification glass. Click in the content region to magnify the image, shift–click to demagnify it. Click on the Magnification Pane again to return to selection mode (crosshairs).

The Colour Palette

The colour palette floating window allows the fractal colours to be changed.Click on the colour in the list box to select it, and then adjust the sliders to achieve the colour you want.

You can select more than one colour by clicking on the first colour, then Command–clicking on additional colours. The Blend button then becomes enabled. Click on this to create a gradient between the selected colours.

If you hold down the Option key when over the content region of the document window, it changes to an eye-dropper. Click to select the colour under the dropper in the palette list box.



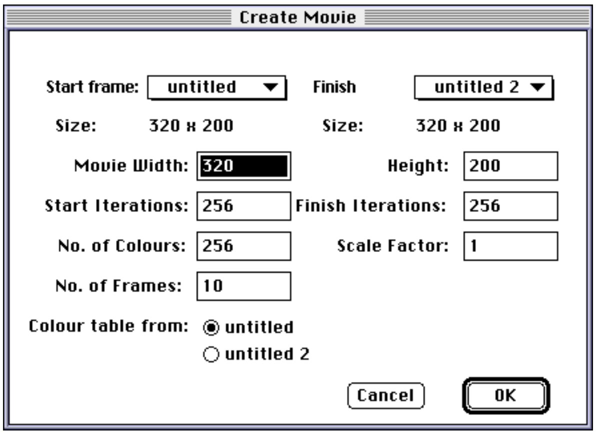
The Special Menu

Parameters	Shows the parameters for the current fractal.
Selection Details	Gives the dimensions of the current selection, in terms of pixels and in terms of the complex plane.
Pause	Pause the current generation.
Resume	Resume a paused generation.
Generate Selection	Take the current selection and create a parameters dialog from it, in order to generate a new fractal.
Print Resolution	The resolution to print the fractal at.

Creating a Movie

Movies can be created between fractals of the same type, e.g., between two Simple Mandelbrots, or between two Henons. Fraxious will attempt to create animation frames between the two fractals, interpolating values that can be interpolated. Examples of possible animations are: zoom from a Simple Mandelbrot to another which has been created from a selection of the first; similar zoom from one Lyapunov to another; from one Henon to another with *a* different a value; from one Julia Set to another with different Re and Im values; from a General Mandelbrot of $z^2 + c$ to one of $z^{15} + c$.

To create an fractal animation, choose New MovieÉ from the Movies menu. You will then be presented with a dialog box like this one (the details will vary between fractals):



Note that you can change the size of the movie, and also number of iterations, and number of colours. A scale factor of more than 1 causes the fractal to be rendered in an expanded area and then dithered into the final movie size, giving a sort of anti-aliasing. This is useful for black-and-white images which otherwise look jagged (but remember to choose grayscale rather than Black-and-White in the compression dialog).

Following this dialog, you will be presented with the standard Macintosh compression dialog and standard Save dialog.

Open MovieÉ will allow you to play back the movie. Alternatively, you can play it with Movieplayer or similar program.

Memory Requirements

There is a large variation between the memory requirements for different fractals. FM2D needs a lot of memory as it uses a large array of floating point numbers. Using more than 256 colours uses a lot of memory, as does the Continuous Potential Method, and, of course, the bigger the fractal, the more memory it uses.