>

ΝΑ μελετηθεί η παρακάτω Απεικόνιση :

$z_{n+1} = f_c(z_n) := \rightarrow (z_n)^2 + c$: **όπου**

$z_n = x_n + I \cdot y_n$, $z_{n+1} = x_{n+1} + I \cdot y_{n+1}$ & $c = a + I \cdot b$:

Mandelbrot : Γιά $z_0 = \mathbf{0 + 0 \cdot I}$ με την ανωτέρω απεικόνιση έχουμε την Τροχιά :

> $f_c := z \rightarrow z^2 + c$

$$f_c := z \mapsto z^2 + c \quad (1)$$

> $f0 := 0 + 0 \cdot \mathrm{I}$

$$f0 := 0 \quad (2)$$

> $f1 := f_c(0)$

$$f1 := c \quad (3)$$

> $f2 := f_c(f1)$

$$f2 := c^2 + c \quad (4)$$

> $f3 := f_c(f2)$

$$f3 := (c^2 + c)^2 + c \quad (5)$$

> $f4 := f_c(f3)$

$$f4 := ((c^2 + c)^2 + c)^2 + c \quad (6)$$

> $f5 := f_c(f4)$

$$f5 := (((c^2 + c)^2 + c)^2 + c)^2 + c \quad (7)$$

>

> with(plots) :

> with(plottools) :

Η Μιγαδική Απεικόνιση $z_{n+1} = f_c(z_n) := z_n \rightarrow z_n^2 + c$ **αντικαθιστώντας** $z_n = x_n + I \cdot y_n$, $z_{n+1} = x_{n+1} + I \cdot y_{n+1}$, $c = a + I \cdot b$ **, είναι ισοδύναμη με τις πραγματικές Απεικονίσεις :**

$$x_{n+1} = \mathbf{u} := (x_n, y_n) \rightarrow x_n^2 - y_n^2 + a$$
$$y_{n+1} = v := (x_n, y_n) \rightarrow 2 \cdot x_n \cdot y_n + b$$

και λύνοντας Αντίστροφα ως προς ΠΡΑΓΜΑΤΙΚΑ x_n, y_n **παίρνει την μορφή :**

$$\left\{ x_n = -\frac{b - y_{n+1}}{\sqrt{2\sqrt{a^2 - 2\,a\,x_{n+1} + b^2 - 2\,b\,y_{n+1} + x_{n+1}^2 + y_{n+1}^2} + 2\,a - 2\,x_{n+1}}}, y_n \right.$$

$$= \frac{\sqrt{2\sqrt{a^2 - 2\,a\,x_{n+1} + b^2 - 2\,b\,y_{n+1} + x_{n+1}^2 + y_{n+1}^2} + 2\,a - 2\,x_{n+1}}}{2}\Bigg\},$$

$$\Bigg\{x_n = \frac{b - y_{n+1}}{\sqrt{2\sqrt{a^2 - 2\,a\,x_{n+1} + b^2 - 2\,b\,y_{n+1} + x_{n+1}^2 + y_{n+1}^2} + 2\,a - 2\,x_{n+1}}}, y_n =$$

$$- \frac{\sqrt{2\sqrt{a^2 - 2\,a\,x_{n+1} + b^2 - 2\,b\,y_{n+1} + x_{n+1}^2 + y_{n+1}^2} + 2\,a - 2\,x_{n+1}}}{2}\Bigg\}.$$

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> with(Fractals:-EscapeTime)
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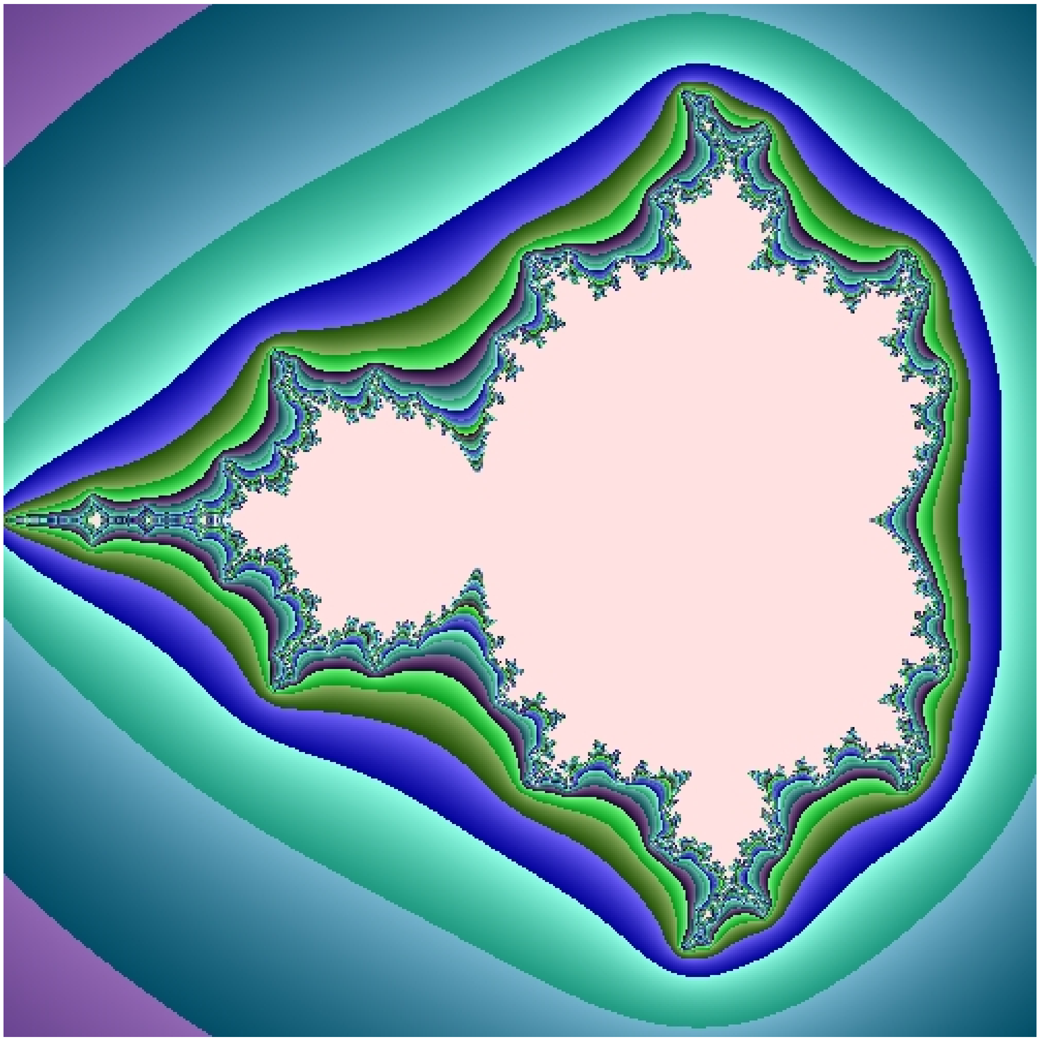
[BurningShip, Colorize, HSVColorize, Julia, LColorize, Lyapunov, Mandelbrot, Newton] **(8)**

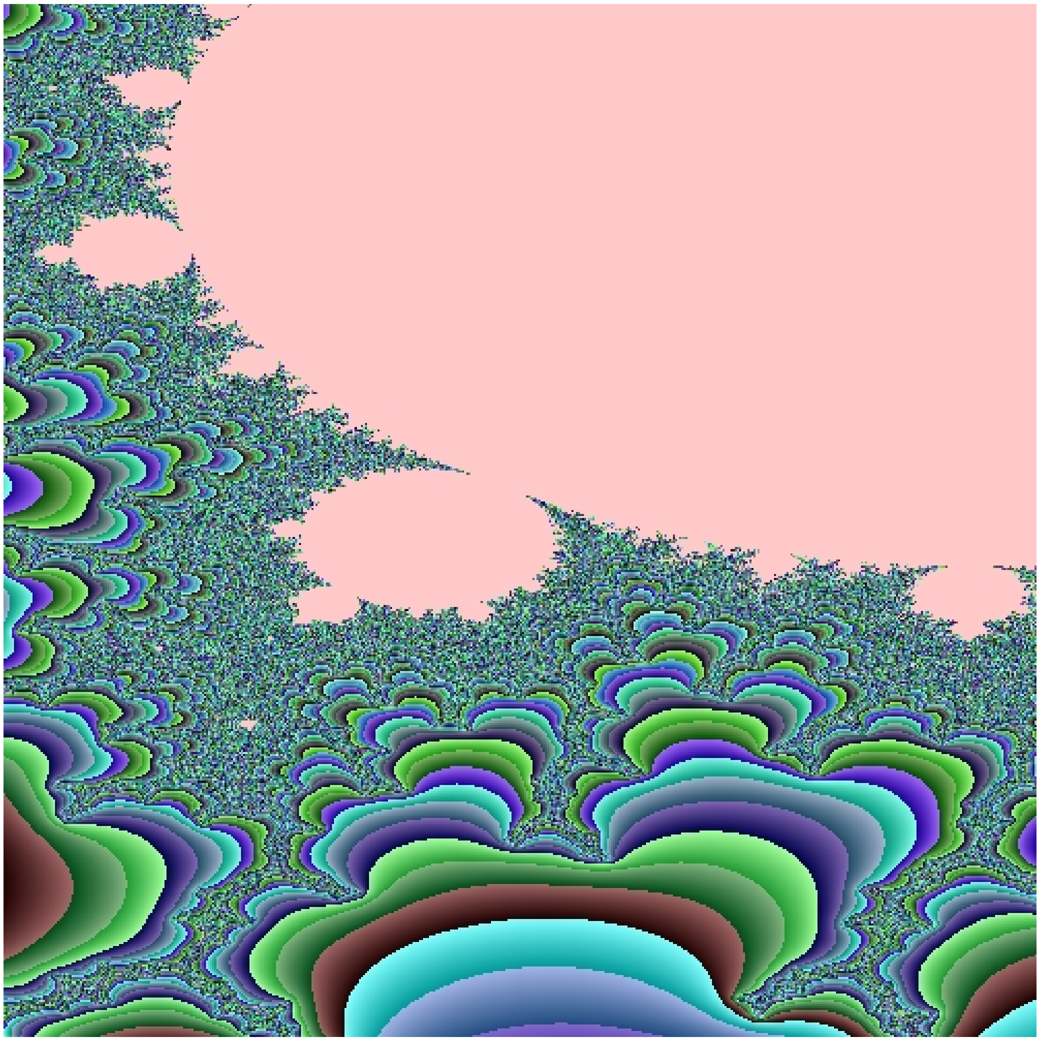
```
> with(ImageTools) :
> M := Mandelbrot(500, -2.0 - 1.35 I, 0.7 + 1.35 I)
```

$$M := \begin{bmatrix} \text{1..500 x 1..500 x 1..3 Array} \\ \text{Data Type: } float_8 \\ \text{Storage: rectangular} \\ \text{Order: C\_order} \end{bmatrix}$$ **(9)**

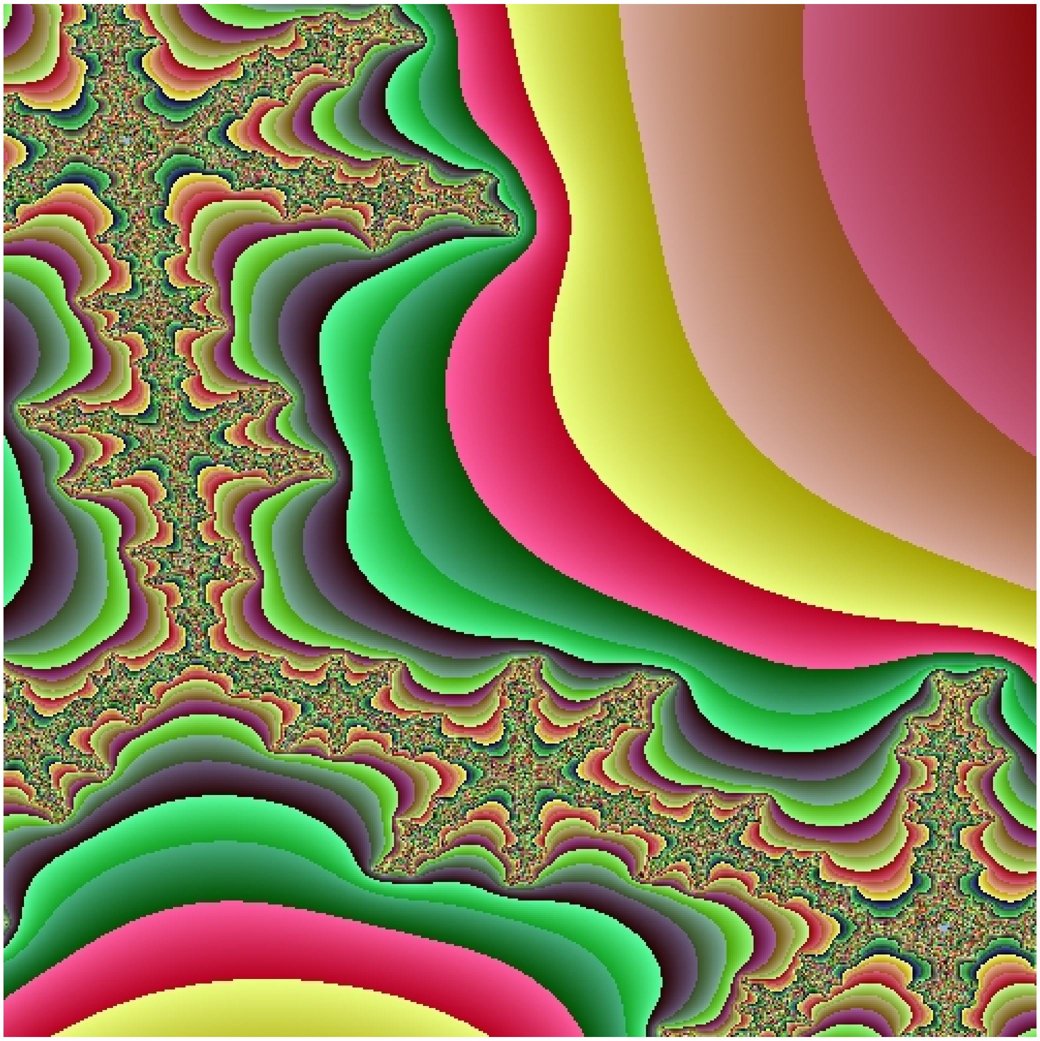
```
> Embed(M)
```



```
> Embed(Mandelbrot(500, -2.0 - 1.35 I, 0.7 + 1.35 I, output = layer1)) :
> Embed([Mandelbrot(200, -2.0 - 1.35 I, 0.7 + 1.35 I, iterationlimit = 10, output = layer1),
      Mandelbrot(200, -2.0 - 1.35 I, 0.7 + 1.35 I, iterationlimit = 25, output = layer1),
      Mandelbrot(200, -2.0 - 1.35 I, 0.7 + 1.35 I, iterationlimit = 125, output = layer1)]) :
> Embed(Mandelbrot(500, -0.1515 + 1.032 I, -0.1575 + 1.043 I, iterationlimit = 300, cutoff
      = 50.0))
```



```
> Embed([Mandelbrot(200, -2.0 - 1.35 I, 0.7 + 1.35 I, cutoff = 4.0, output = layer2),
      Mandelbrot(200, -2.0 - 1.35 I, 0.7 + 1.35 I, cutoff = 100.0, output = layer2),
      Mandelbrot(200, -2.0 - 1.35 I, 0.7 + 1.35 I, cutoff = 10000.0, output = layer2)]) :
> R := Array(1 ..500, 1 ..500, 1 ..2, datatype = float_8) :
> Mandelbrot(500, -0.1025 + 0.95 I, -0.095 + 0.96 I, iterationlimit = 200, cutoff = 50.0, output
      = raw, container = R) :
> Embed([FitIntensity(R_(() ..(), () ..(), 1)), FitIntensity(R_(() ..(), () ..(), 2))]) :
> P := Colorize(500, R, Array([11, 3, 2], datatype = integer_4), Array([0.256, 0.859, 0.256],
      datatype = float_8), rgb = 0, mode = 4, layer = 2) :
> Embed(P)
```



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