Mandelbrot for Windows
Version 1.1
by Robert Epps

Help Topics:

Overview

Mandelbrot for Windows allows you to view the Mandelbrot set in the Windows environment. When you start it up, it will immediately begin drawing the entire Mandelbrot set. If you resize the window, MBW will start over again, drawing the set in the new window size. The program will run in the background, even if it is reduced to an icon. When MBW is finished drawing the image, an asterisk will appear next to the word "Mandelbrot" in the title bar of the window.

At any time, you can magnify, or "zoom", an area of the image. To do this, you must first draw a "Zoom box". Move the mouse pointer to the upper left corner of the area you want to magnify, then press and hold the left mouse button. Move the mouse pointer to the lower right corner of the area you want to magnify, and release the mouse button. If you want to select another area, simply repeat those steps. When you have selected the area you wish to magnify, select **Zoom In** in the **View** menu. A new MBW window will appear on the screen, which will begin drawing the magnified area. The original window will stop drawing, so that more CPU power will be available for the new window. If you want the original window to continue drawing its image, select **Resume** in the **View** menu of that window.

You can change the color scheme that MBW uses to draw the image by selecting **Colors** in the **Options** Menu. I provided the various choices mainly because I could not decide upon a "best" scheme for all systems and display types. The different schemes are described under the topic "What is the Mandelbrot Set?" . The 24-bit RGB schemes will probably give you the best-looking images for most color systems. Just experiment until you see what you like!

File Menu Commands

NEW	Resets the program. MBW will redraw the entire Mandelbrot set again.
OPEN	Allows the user to open a previously saved image file.
SAVE	Saves the current image to disk.
SAVE AS	Requests new file name, then saves the current image to disk.
EXIT	Closes the MBW window.

Edit Menu Commands

COPY Copies the image to the clipboard. If the Zoom box is visible, then the area inside the Zoom box is copied to the clipboard.

View Menu Commands

ZOOM IN	Opens a new MBW window, which draws a magnified view of the area of the current window that is inside the Zoom box.
CLONE	Opens a new MBW window, which draws the same image as the current window.
FREEZE	Suspends drawing in the current window.
RESUME	Resumes drawing in the current window.

Options Menu Commands

LIMIT	Allows the user to view or change the Mandelbrot iteration limit.
EXTENTS	Allows the user to view or change the current drawing extents.
COLORS	Allows the user to change the iterations-to-colors mapping scheme.

What is the Mandelbrot Set?

I was afraid you'd ask that. Although I know how to program it and make it dance and sing, the theory of the Mandelbrot set (and fractal geometry in general) pretty well whizzes over my head like an F-15. So, at great risk of bringing smirks to the faces of more learned individuals who might be reading this, I will attempt to explain what this program is drawing . . .

Basically, the Mandelbrot set (named after the mathematician Benoit Mandelbrot) is the set of all complex numbers C such that the equation $Z = Z^2 + C$ converges, where Z is initially the complex number $(0 + 0i)$. A complex number can be represented as a pair of real variables, such as (x, y) to represent $(x + yi)$, and can thus be plotted on the screen.

The initial screen that MBW draws is the set of all complex numbers C from $(-2 - 2i)$ to $(2 + 2i)$. For each C, the program sets Z to zero, then repeatedly computes the above equation. The program stops calculating either when Z stops changing (it is converging), or when it is diverging (its absolute value is greater than 4). If Z is converging, then C is in the Mandelbrot set, and it is plotted in white. If Z is diverging, then C is plotted in a color based on the number of times the equation was calculated before the absolute value of Z became greater than 4.

It can sometimes take a long time for the equation to converge, and occasionally the value of Z will "oscillate" around some value instead of converging to a value. So that the computer does not have to spend gobs of time calculating, an "iteration limit" is used to limit the number of times the equation is recalculated before MBW decides that the equation is converging. This limit can be set by selecting **Limit** in the **Options** menu. You will find that as you zoom deeper into the Mandelbrot set, you will have to set the limit higher so that MBW can continue to draw the image accurately. (If anyone knows how to automatically set the limit based upon the drawing extents and precision, I would sure love to know the formula!!)

The method by which MBW converts the iteration count to an RGB color value depends upon the color mapping scheme selected. The eight and sixteen color schemes are pretty straightforward; the iteration count modulo eight or sixteen is used as an index into a table of the eight (or sixteen) basic RGB colors. The first 24-bit scheme "scales" the iteration count; that is, it multiplies the count by a scaling factor so that the highest possible iteration count (the iteration limit), becomes $2^{24} - 1$. That value is then used as the RGB color value. The second 24-bit scheme converts the iteration count to an RGB value based upon a rather complex algorithm that attempts to draw the image with smooth, gradual color changes.

If anyone spots bugs, or has any comments, suggestions, gripes, etc., please write! You can reach me on GEnie (R.EPPS), CompuServe (72560,3353), BIX (repps), or Prodigy (GPKT94A). Or write to me at: 208 Preble Drive #E, Tustin, CA 92680-3743.