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The Index contains a list of all Help topics available for Chaos. For information on how to use Help, press F1 or choose Using Help from the Help menu.

In addition, you can press Shift-F1 and then click on a menu item to get help for that menu item.

Draw/Pause/Resume Button

A mouse click on the Draw button starts drawing the current fractal image.

While drawing is in progress, the button changes to the **Pause** button.   Click this to suspend calculation without losing your place.   While drawing is paused, the button is titled **Resume**.   Click Resume to continue drawing where you paused.

Choose Button

The **Choose** button brings up a dialog box that lets you to choose which type of fractal image to generate.   In this application, there are three possibilities: the Mandelbrot set, Julia sets, and fractal dragons.

Parameters Button

The **Parameters** button brings up a dialog box that lets you select values that are used to compute and display the type of fractal image you have chosen.

There are two types of values you can set in this dialog:

Computation options:

These four values determine what the set will look like.

Zreal: This is the real part of the seed value.
Zimaginary: This is the imaginary part of the seed value.
Maximum distance: The function stops iterating as soon as the value of the function reaches or exceeds this value.
Number of iterations: If the value of the function never reaches Maximum Distance, the function will stop iterating after this many iterations have been completed.

Display options:

The first four options control the position and size of the <u>viewport</u>.

X: The X value of the center of the viewport
Y: The Y value of the center of the viewport
Width: The width of the viewport
Height: The height of the viewport

Color Scale: Tells the program how many entries to skip in the palette. A value of one means that no entries are skipped, and produces very smooth shading.   A value of 10 skips 9 palette entries, and produces high contrast images.
Color Scale 4
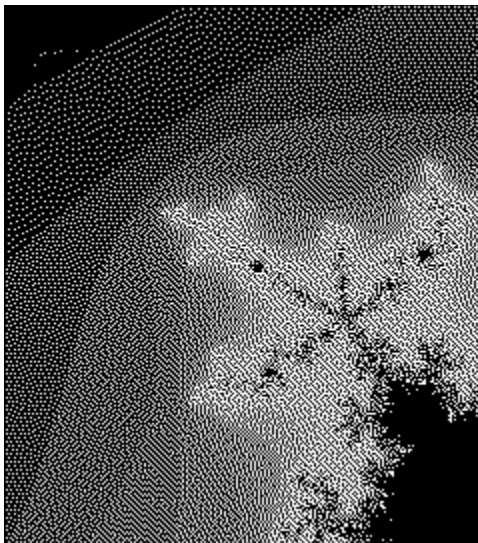
Color Scale: 6
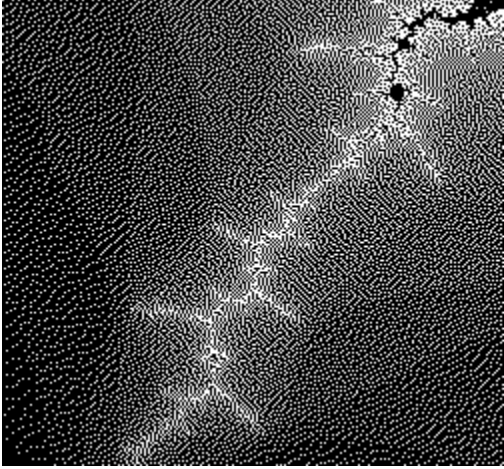
Pixel Size Button

This button allows you to choose how fast you want the fractal image to compute, and how accurate you want it to display.   Since these logical pixels are always square, you cannot set the aspect ratio, just the dimensions.

The four choices are:
> Smallest Pixels - This sets the logical pixel size to the smallest possible (1 X 1, so one logical pixel equals one screen pixel).   This will create the best looking image, but will take the longest.
> Smaller Pixels - This reduces the current logical pixel size by half.   This helps to get a better idea of what the area in your viewport looks like, but will take about 4 times longer to paint the whole screen.
> Bigger Pixels - This increases the logical pixel size by a factor of 2.   You will get much faster painting, but the image will look all blocky.
> Biggest Pixels - This just gives you a rough estimate of what the area in the viewport will look like.   However, the painting is very fast.

Of course, there is a trade-off.   You want it to be very accurate, and display very quickly. Unfortunately, you can have one or the other: high accuracy means slower painting, and vice versa.

To get greater accuracy you want small pixels.   This means that there are more of them that the computer has to calculate, and more calculation takes more time.

To get faster painting, you want smaller pixels.   That means that there are less of them that the computer has to calculate, and fewer calculations take less time.

Zoom Out Button

This button allows you to back off from the region you are currently painting.   It increases the viewport size by 25%.

Edit Palette Button

Use the right mouse button (or arrow keys when the palette control has the focus) to place the current palette indicator box (the rectangle that outlines the palette entry).

Once on the entry you want to edit, you can use the scroll bars to adjust the Red, Green, and Blue values.

Use the left and right mouse buttons to place the little triangles on either end of the range you want to shade.   Pressing the shade button will produce an even shading of the palette entries between the little triangles.
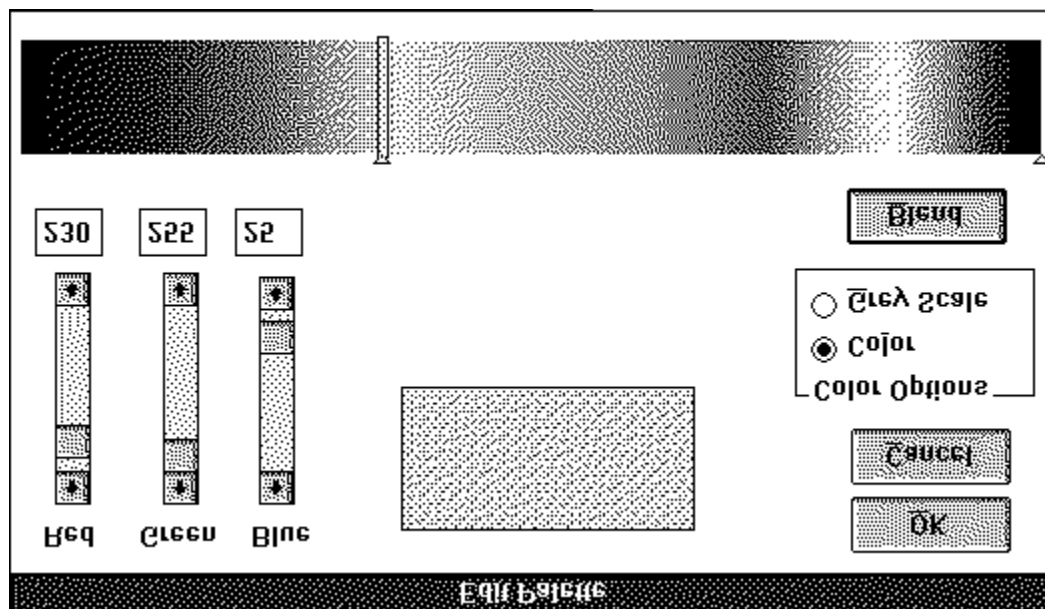
If you want to draw a grey scale mandelbrot, change the palette from Color to Grey Scale. After changing the Color Options, you will have to recalculate the fractal set with the new values.

File Menu

The File menu includes commands that enable you to establish a new workspace and to exit the application.   In this version, the application does not load or save files.

For more information on a command, select the File menu command name below:

New   Clears the screen in preparation for drawing a new image.
Exit   Exits the application

File New Command

Clears the screen of the current image.

For this command, from the main menu, choose File, and then New.

The keyboard accelerator for this command is **Shift-Delete**.

File Exit Command

Exits the Chaos application.

To exit, you may also :
      Choose Close off the system menu
      Double click on the system menu

For this command, rom the main menu, choose File, and then Exit.

The keyboard accelerator for this command is **Alt-F4.**

Edit Menu

The Edit menu includes commands that enable you to edit the current palette and copy images to and from the clipboard.

For more information, select the Edit menu command name below:

Palette Brings up the Edit Palette dialog box.
Copy   Copies the current image to the clipboard.   If there is no current image, this option is greyed out.
Paste DDB   Gets the current DDB from the clipboard.   If there is no DDB on the clipboard, this option is greyed out.
Paste DIB   Gets the current DIB from the clipboard.   If there is no DIB on the clipboard, this option is greyed out.
Paste Palette Gets the palette from the clipboard and uses it to draw the current fractal type.   If there is no palette on the clipboard, this option is greyed out.

Edit Copy Command

To copy an image from the active window to the clipboard, choose COPY off of the EDIT menu.

This operation will put the current image onto the clipboard in two formats:
Device Dependent Bitmap Format (<u>DDB</u>) (with an accompanying palette if you are in 256 color mode).
Device Independent Bitmap Format (<u>DIB</u>)

The keyboard accelerator for this command is **Ctrl-Insert**.

Edit Paste DDB Command

To paste an image from the <u>clipboard</u> to the current window, select PASTE from the edit menu.

The keyboard accelerator for this command is **Shift-Insert**.

Edit Paste DIB Command

To paste an image from the <u>clipboard</u> to the current window, select PASTE from the edit menu.

The keyboard accelerator for this command is **Shift-Insert**.

Edit Paste Palette Command

To paste an image from the <u>clipboard</u> to the current window, select PASTE from the edit menu.

The keyboard accelerator for this command is **Shift-Insert**.

Options Menu

For more information, select the Options menu command name:

Step   Toggles whether the Chaos program will stop after completion of each
                screen.

Status Window   Toggles whether the status window is visible at the bottom of the
                screen.
View Palette   Brings up a dialog box that displays the current palette.

Options Step

This option controls whether the program keeps painting the screen with successively smaller pixels, or just draws once with the current pixel size.   When step mode is ON, a check mark appears next to the **Step** item on the menu.
When step mode is ON, you must click the Draw button to restart drawing after each screen
 finishes painting.

When step mode is OFF, painting will continue until the program reaches the maximum
 resolution of your hardware.

Options Status Window
Toggles whether the status window is visible at the bottom of the screen.   The status window is where menu help is displayed, and the status of the current fractal computation.

If you turn the status window off, you get slightly more screen area to view the fractal. Having the status window visible does not affect how much of the image is pasted to the clipboard.

Options View Palette
This menu item brings up a dialog box that displays the current palette.   This is only used to view the palette.   To change the palette, you must choose <u>Palette</u> off the **Edit** menu.

Creating Fractal Images

When you start up Chaos, it will have a pre-calculated image of the Mandelbrot set on the screen.   At this point you can choose another type of fractal (with the **Choose** button) or use the mouse to drag a box around an area you are interested in.

Once you have dragged a box around the area you are interested in, drawing will commence.   If you have the step mode turned off, Chaos will draw a rough approximation of the area of the fractal image you have selected, and then repeat.   Each successive drawing will have higher and higher resolution, until it reaches the maximum resolution of your hardware.

If you want the software to wait for you to tell it to draw after each pass, turn step mode on.

If you want to draw in the highest resolution without waiting, click on the **Pixel Size** button and choose "smallest".

Using the mouse to navigate an image

Once you have a fractal image on the screen, you can "drive around" using the mouse.
To do this:
     - Drag a box around the area you want to explore.
     - When you release the mouse button, the area you selected will be stretched to fill
      the screen, and the fractal computation will begin again, using the parameters of the
      new location.

You can do this as many times as you want.   The beauty of fractals is that you never run out
of things to explore - you will finally bottom out when your computer starts rounding off
digits.

Copying Images

To copy an image to the clipboard, choose Copy off of the Edit menu.   This will place a copy of the image in device dependent format.

In 256 color mode, it will also place an accompanying palette that describes all the colors used in the image.

Clearing an image

To erase the current image, choose New from the File menu.   This will clear the screen, and reset the state of the program to when you started.

Exiting

To exit Chaos, choose Exit from the File menu, or from the system menu.

Registration

Why to register:

       Registration gets you the latest version of the software, it puts you on the mailing list to be notified of future updates, and it gives me the incentive to fix bugs and write more code, because I know someone is using the software.

What you get:
       - If I have fixed a lot of bugs or added new features, I will create a new release of the software.   If there is one newer than the one you have, I will send you a copy of the newest release of the software.   Includes:
         Bugfixes
         New Features
         Improvements (easier to use, faster computation)

How to register:
Send $15 (check or money order) to Chuck Lindgren.

Mailing address:

Chuck Lindgren
c/o Iris Associates
1 Technology Park
Westford, MA 01886

To register, use the form on the following page (hit the [Browse >>] button above, then print the form to by selecting Print from the File menu).

Invoice

Remit To:

Chuck Lindgren
c/o Iris Associates
1 Technology Park
Westford, MA 01886

From:

Number of copies: ____   @ $15 each = $ ____

I use 5 1/4"/3 1/2" disks (circle one)

They are low/high density (circle one)

I got Chaos from a bulletin board/shareware distributor (circle one)

Name of bulletin board/shareware distributor: _____

I currently have version 1.0 of Chaos.   Please send me a newer version if one exists.   If so, upon receipt of this paid invoice, your diskette will be sent out.

Comments (likes, dislikes, suggestions, new feature requests):

Hardware Configuration

This software was developed and tested on a Compaq 386/20 with a color monitor, a VGA graphics card, and a mouse.   The graphics card is one of the Video 7 types for which Windows supplies a 256 color driver.

Speed of computation:
Unfortunately, if you have a substantially slower machine, fractal computation can take a *long* time (depending on the resolution you select, and the number of iterations you are computing).   Even with a fast machine, some high resolution full-screen fractal images can easily take hours to compute.   However, there are a couple of things you can do to make it easy on yourself.

> **Pixel size:**   That's easy -   the bigger the pixels, the fewer there are to calculate.
>
> **Number of iterations:**   When you hit the **Parameters** button, a dialog box comes up that asks you for a bunch of parameters.   One of these is "number of iterations" (default is 256 for Mandelbrot).   If you make this a smaller number, the resulting image is sometimes less complex, but may compute much faster.
>
> **Amount of area in "the set":**   The area that shows up as black in an image is described as actually being part of the Mandelbrot set.   It is defined as all points for which the maximum number of iterations is reached without exceeding the threshold value.   Basically, the black part is the most expensive, computation-wise.   If you choose an image to compute without much black part, it will compute much faster than one with a lot of pixels in the Mandelbrot set.

> Finally, if you must compute a monster fractal image, do it overnight or in the background (while you are doing something else with another application in Windows).   Warning: computing fractals in the background will use up CPU time, and slow down whatever you are doing in the foreground!

Image Quality:
If you do not already have one, I strongly urge you to go out and get a video board that has a driver that will display 256 colors in Windows.   They are not that expensive (there are several for under $200), and the difference it makes when you are using color intensive graphics applications is phenominal.

New Features

I am always thinking of new features or improvements to existing features.   To receive updates containing new features, improvements, and bugfixes, send in your registration fee. In addition, registered users are welcome to make suggestions for new features.

Coming Attractions

Here are a few of the things that may appear in future releases:

- Improved status window, telling the fractal type and parameters
- Finished help system, with Shift-F1 hooked up to all menu items
- Hooks to allow user to design own "fractal generators".   You put description in
    WIN.INI and Chaos will call your DLL and paint the results.
- Palette animator
- Iterated Function Systems
- Speeding up fractal calculation and screen painting
- File I/O
    Windows 3.0 and OS/2 bitmaps
    Maybe TIFF or PCX
- Printing

Known Bugs

I am continually working on this application, and periodically cut a release when I feel that I have accumulated enough new features and bugfixes to make it worth while.   Inevitably, there are some bugs that I either didn't know about, can't find, or don't bother to fix.

This list is intended to give you and idea of what to expect, and of what I hope to fix in the next release.

       This help system is not yet finished.
       Need "default" button on edit palette dialog

If you find a bug not on this list, send it in with your registration, and I will try to make sure it gets fixed in the next release.

Glossary

Clipboard
DDB
DIB
Fractal Dragon
Fatou, Pierre
Fractal
Julia, Gaston
Julia Set
Mandelbrot, Benoit
Mandelbrot Set
Viewport

Clipboard

The Windows clipboard enables you to share data between applications.   If you copy an image to the clipboard, you can then paste it into any Windows application that contains clipboard support.

Example:

Problem:
        You want to save the bitmap in your current window in TIFF format.
Solution:
        Copy the image to the clipboard.   Paste it into an application that supports the TIFF file format.   Save the image from that application.

Mandelbrot Set

All points c associated with connected Julia sets.

Viewport

A viewport is a window that you use to view the fractal patterns.   You can change the size and position of a viewport by dragging an area with the mouse, using the Parameters button, or the Zoom Out button.

Julia Set

The Julia set is composed of fractal boundaries that emerge from the iteration of the quadratic transformation $z2+c$.   They take on a bewildering variety of shapes that depend only on the number c, called a *control parameter*.   Some values of c lead to Julia sets that are in one piece.   Other values yeild Julia sets that are disconnected and dust-like.

Dragons

A kind of fractal image, so named because of their visual similarity to the classical dragon shape (like the traditional Chinese tapestry representations).

Fractal

A term coined by Benoit Mandelbrot to describe all curves whose Hausdorff-Besicovitch dimension is greater than their Euclidian dimension.

From the Latin *fractus*, the adjectival form of *frangere*, or "to break".

DIB

The Device Independent Bitmap format was introduced by Microsoft in Windows 3.0.   It consists of a bitmap header containing information about the bitmap (like the dimensions and number of colors) followed by a color table (containing either RGB values or indices into a palette) followed by the bits of the image.

The advantage to this format is that a bitmap created on one system can be transferred to another system with different dispay capabilities.   When the second device tries to render the bitmap, it can use the information stored in the bitmap to make intelligent decisions about how best to convert the display format.

DDB

Bitmap that relies on the specific characteristics of a device for proper display (resolution, number of colors, pixel aspect ratio).

Benoit Mandelbrot

A mathemetician at the IBM Thomas J. Watson Research Center in Yorktown Heights, N.Y., Mandelbrot is best known for coining the term "fractal" in 1975 to describe certain phenomena (such as coastlines, snowflakes, and mountains) whose patterns repeat themselves at smaller and smaller scales.

Though generally accepted as the discoverer of the set with it's unique fractal properties, some controversy exists.   An interesting discussion of the set's origin can be found in the April 1990 issue of *Scientific American*, on page 30.

Gaston Julia

Successfully claimed that the work he did was more significant than Fatou's.   Taught Mandelbrot in the late 1940's.

Pierre Fatou

An early researcher in the field of iterative functions, Fatou described some of the set's peculiar properties as early as 1906.

References

These publications prove interesting reading to those interested in the theory or just curious about fractals.

Gleick, James, *Chaos*, New   York, New York, Penguin Books

Horgan, John, April 1990, "Mandelbrot Set-to", *Scientific American*,   page 30.

Jurgens, Hartmut, Peitgen, Heinz-Otto, and Saupe, Deitmar, August 1990, "The Language of Fractals", *Scientific American*, page 60.

Hill, F. S. Jr., *Computer Graphics*, Macmillan Publishing Co.

Stevens Roger T., *Fractal Programming in C*, Redwood City, CA, M&T Books

To do:

Optimal calculation for images straddling the x-axis
Excel style 3-D status bar
When minimized, icon title is percent done (like WinGif)
CreateDialog instead of DialogBox for view palette
Keyboard interface for ribbon buttons (accelerators, tab, sh-tab)
ribbon button on a toolbox
copy DIB to clipboard
default palette goes from blue to gold
draw pkg in a DLL to take advantage of 387 when present
shift-F1 help for ribbon buttons