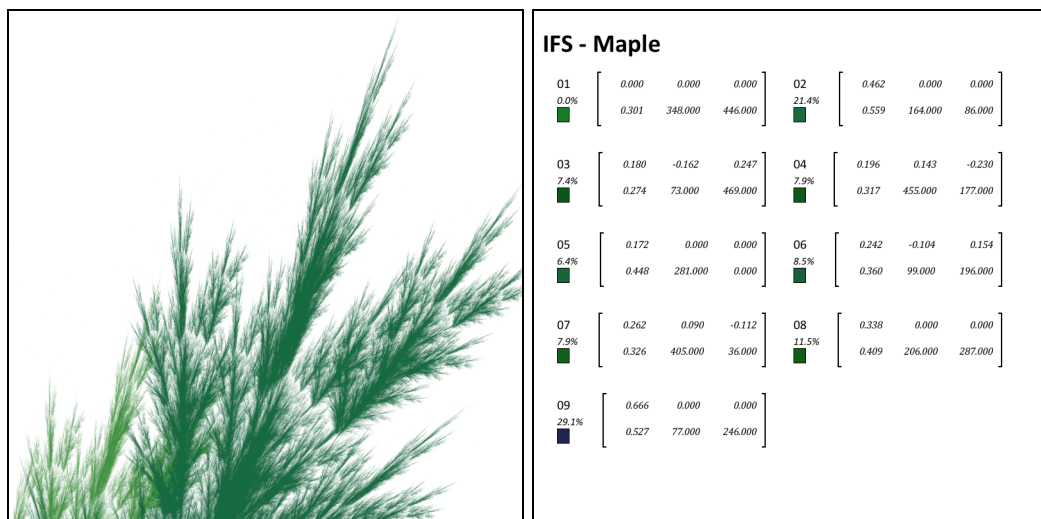


# IFS Explorer

Version 1.0.7

An interactive **Iterated Function System** explorer. This program allows you to explore a vast world of complex and beautiful fractal images produced by simple mathematical rules, through a process of trial and error, experimentation and exploration. See the *References* section below for more details on the mathematics and concepts behind these systems.

**IFS Explorer** provides an interactive UI to create and manipulate a set of affine transforms, which are then iterated randomly to produce an image. The Java `AffineTransform` class is used to represent and plot the transforms. The systems can be saved and loaded as XML files, and rendered images can be exported as PNG graphics files.



Screenshots for the **Viewer** and **Details** modes.

## Program requirements

- Java 1.7.0 Runtime Environment
- Windows, Linux or OSX Operating System
- Maven and 1.7.0 JDK for building (*Optional*)


## Instructions

Either build the program using Maven or extract one of the packaged distributions. These can be [downloaded from GitHub](#) as either `.tar.gz` or `.zip` archives. Then run the relevant script for your operating system.

```
$ ./bin/explorer.sh [-f] [-c] [-p] [ifs.xml]
$ ./bin/explorer.command [-f] [-c] [-p] [ifs.xml]
C> .\bin\explorer.cmd [-f] [-c] [-p] [ifs.xml]
```

Alternatively, the `iterator-1.0.7-jar-with-dependencies.jar` jar file can simply be downloaded and executed directly, with the `java -jar` command.

```
$ java -jar iterator-1.0.7-jar-with-dependencies.jar
```



The ASCII art logo consists of several rows of characters. The first row has three groups of three underscores. The second row uses a mix of vertical bars, underscores, and backslashes to form a more complex shape. The third row continues this pattern with various symbols. The fourth row features a central 'X' shape formed by backslashes and forward slashes. The fifth row has a central vertical bar. The overall shape is roughly rectangular with a central vertical element.

Iterated Function System Explorer Version 1.0.7  
Copyright 2012-2013 by Andrew Donald Kennedy  
Licensed under the Apache Software License, Version 2.0  
<https://grkvlt.github.io/iterator/>

The program can be controlled by setting properties (see the *Configuration* section) or by specifying flags as command-line arguments. To place the application into full-screen mode add the `-f` or `--fullscreen` flag to the command-line.

Enable colour rendering with the `-c` or `--colour` flag. This will use a fixed list of colours for the transforms. To use a colour palette taken from a sample image, specify `-p` or `--palette`. The image used can be set with the `explorer.palette.file` system property and can be one of *abstract*, *wave* or *car*.

# Configuration

- `explorer.grid.min` - Minimum grid spacing - *10*
- `explorer.grid.max` - Maximum grid spacing - *50*
- `explorer.grid.snap` - Snap-to-grid spacing- *5*
- `explorer.palette.file` - Colour palette image source - *abstract*
- `explorer.palette.size` - Number of colours in palette - *64*
- `explorer.palette.seed` - Random seed used for choosing colours - *0*
- `explorer.window.width` - Width of main window - *600*
- `explorer.window.height` - Height of main window - *600*
- `explorer.debug` - Enable debugging mode - *false*
- `explorer.mode` - Setup colour mode - *palette*

The configuration options listed can be set in a property file, which can then be loaded by the application. The locations searched for configuration files are the users HOME directory, for a file named `.explorer.properties`, the current directory for a file named `explorer.properties` and finally the file specified on the command line using the `--config config.properties` option.

```
$ ./bin/explorer.sh --config debug.properties ./data/koch.xml
```

It is also possible to set individual configuration options as system properties, using the `JAVA_OPTS` environment variable.

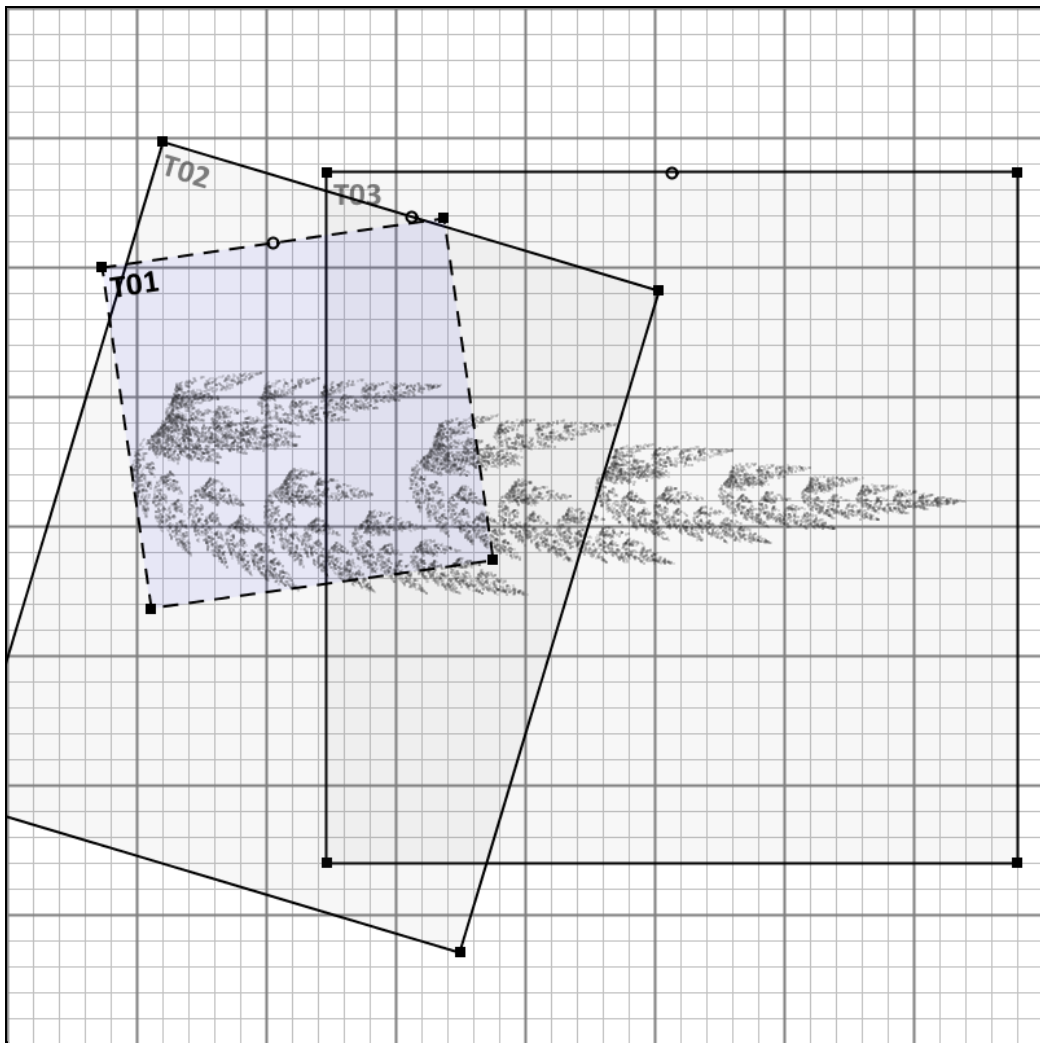
```
$ export JAVA_OPTS="-Dexplorer.palette.file=wave \  
> -Dexplorer.palette.seed=1234"  
$ ./bin/explorer.sh --colour --palette ./data/spikes.xml
```

## Usage

A series of example XML data files for IFS transforms are provided in the `data` directory of the distribution. Some of these can be found in the **The Computational Beauty of Nature** and **Superfractals** books, details of which are given in the *References* section. To load the examples, specify the path to the file as the last argument on the command-line. Sample images for these transforms have also been provided, so be sure to use the `.xml` file, not the `.png`.

Once the program starts, it will display an empty grid in the **Editor** mode. The menus provide access to standard operations, including the ability to switch modes. The keyboard can also be used to toggle between modes using the *Tab* key.

A live view of the generated IFS is displayed at low resolution to give an idea of the eventual rendered image of the fractal. **This capability is unique among IFS generating applications.** It allows much more creativity when designing an IFS. By showing the results of changes to a transform immediately it is possible to reach the desired final image much more quickly.



Screenshot of the **Editor** mode with the live IFS view

In the **Editor** mode, clicking and dragging the mouse will create a new transform which can then be moved, resised and rotated (with **Shift** held down) as desired. In this mode, the **Delete** or **Backspace** key will delete the selected transform and the **Left** or **Right** arrow keys will rotate it by ninety degrees.

The context menu displayed by right-clicking on a transform allows the **z-index** to be raised or lowered, and the selected transform can be moved to the front or back to allow selecting overlapping transforms. A transform can be removed using the **Delete** menu item, or its properties can be altered by choosing the **Properties** option. This will display a dialog allowing the position, size or rotation to be edited.

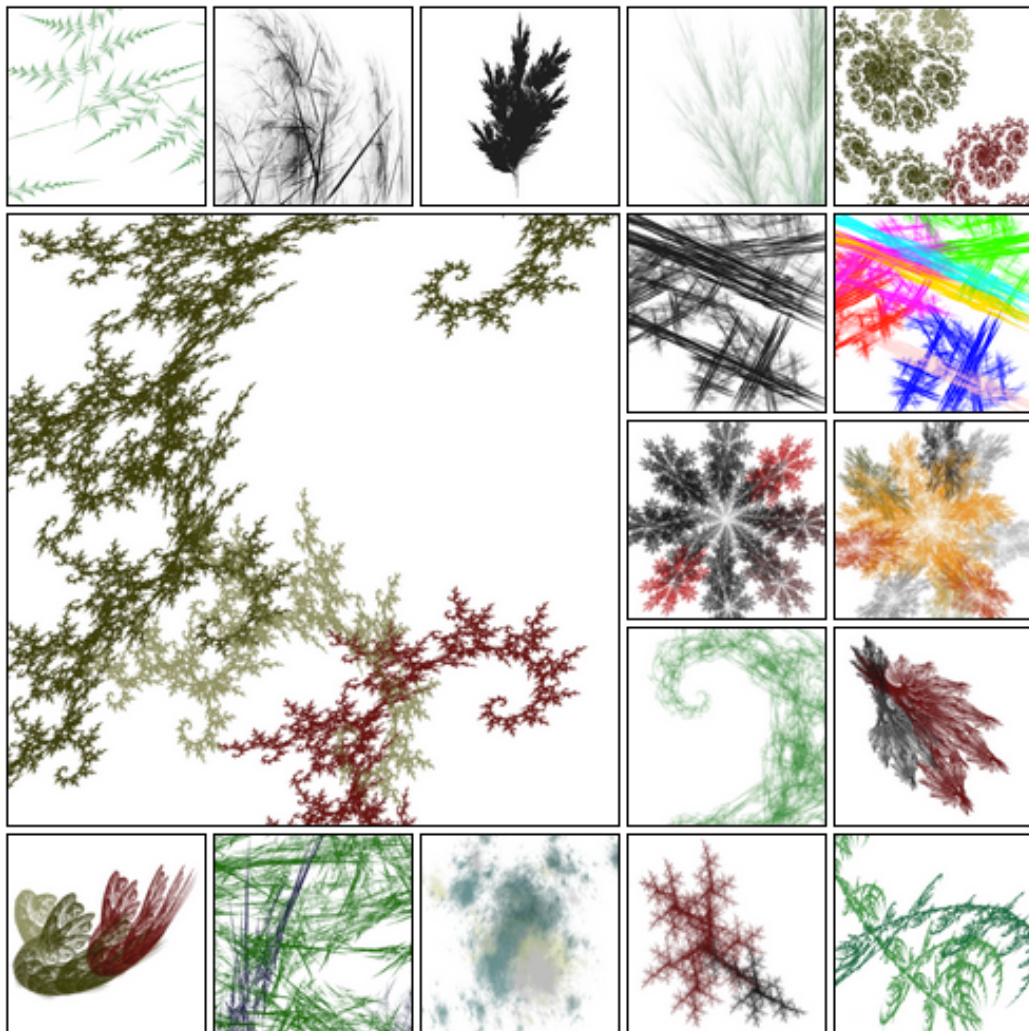
When in **Viewer** mode the **Space** key will pause and continue the rendering process. To zoom into the fractal select a specific area by dragging the left mouse button, or use the keyboard **+** and **-** keys to to zoom in and out of the

centre of the image by a factor of two. The = key will reset the view to the original unmagnified and centered settings.

**Note** that when zoomed in at high magnification the iterative process can take a very long time until the rendered fractal becomes visible.

The **Details** mode shows the actual affine transforms and their matrix coefficients for the system as a scrollable list.

## Examples



*Gallery of example fractal images.*

## TODO

- Preferences dialog
- Better Operating-System integration
  - Printing
  - Native full-screen mode
  - Support native windowing system features

- Better editing UI
  - Edit matrix coefficients
  - Add flip, skew, perspective etc. transforms
  - Preserve aspect ratio on resize option
- Embedded Applet
- JavaFX UI

## References

1. **Iterated Function System;**  
*[http://en.wikipedia.org/wiki/Iterated\\_function\\_system](http://en.wikipedia.org/wiki/Iterated_function_system); Wikipedia*
2. **Affine Transform;** *[http://en.wikipedia.org/wiki/Affine\\_transformation](http://en.wikipedia.org/wiki/Affine_transformation); Wikipedia*
3. **Construction of fractal objects with iterated function systems;**  
*<http://www-users.cs.umn.edu/%7Ebstanton/pdf/p271-demko.pdf>;  
Demko, Stephen and Hodges, Laurie and Naylor, Bruce; SIGGRAPH  
Computer Graphics, Volume 19, Number 3, 1985*
4. **Superfractals: patterns of Nature;**  
*<http://www.amazon.co.uk/SuperFractals-Michael-Fielding-Barnsley/dp/0521844932>; Barnsley, Michael F; Cambridge University Press; 7 Sep 2006; ISBN 978-0521844932*
5. **The Computational Beauty of Nature: Computer Explorations of Fractals, Chaos, Complex Systems and Adaptation;**  
*<http://www.amazon.co.uk/The-Computational-Beauty-Nature-Explorations/dp/0262561271>; Flake, Gary W; MIT Press; 1 Mar 2000; ISBN 978-0262561273*