# AXlife

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# Chapter 1

# AXlife

## 1.1 AXlife Guide

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AXlife 1.1          Based on Xlife 2.0
© 1994 David Kinder     © 1989 Jon Bennett
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## 1.2 About Life

The Game of Life was invented by the mathematician John Horton Conway, and has gone on to become the most famous example of a cellular automata. The idea is to demonstrate that complex behaviour can result from the application of very simple rules, which are:

The game is played on an infinite two-dimensional plane, composed of squares (cells). At any time a cell can only be either alive or dead. Time progresses in discrete steps, with the pattern of live and dead cells at a given time being refered to as a generation. Each new generation depends only on the previous generation. Given a generation, the next generation is calculated by looking at each cell in turn. A live cell will stay alive if surrounded by two or three neighbours, otherwise it will die. A dead cell will be reborn only if surrounded by exactly three neighbours.

To see this in effect, run AXlife and select "Open" from the Project menu. Files to try include "acorn.life" and "rpentomino.life", both of which start with only a few cells but rapidly produce a large pattern, or "puffertrain.life" and "breeder.life", both of which produce an ever growing pattern. Select "Generate" from the Cells menu to start the generation process. Some of the files contain quite detailed comments about the design and purpose of the pattern, which help to teach how to make new patterns.

Life can be used to generate objects of fantastic complexity. Logic gates and even (in theory) a Turing machine (i.e. a completely general computer) can be created. For example, in the included patterns (taken from the Xlife distribution and Al Hensel's IBM PC program "Life") are a prime number sieve, a pseudo-random number generator and several systems for implementing memory registers.

For more information, see:

William Poundstone's "The Recursive Universe" (Oxford University Press)
Martin Gardner's "Mathematical Games" column in Scientific American,
Octocber 1970 and February 1971.

## 1.3 Xlife and AXlife

AXlife is based on Xlife, the definitive life program, which runs under the X-Windows graphical interface (which overlays UNIX). AXlife incorporates an Amiga-specific interface, but the basic generation code remains the same as in Xlife 2.0. AXlife can also read files produced by Al Hensel's IBM PC program "Life", which has a very similar format.

The most important feature of Xlife (and AXlife) is that, unlike most life programs, it does not limit the pattern to the size of the screen. Xlife does not think in terms of a rectangular grid, but instead considers the pattern to be composed of 8x8 boxes containing active life elements. This allows Xlife to cope with arbitrarily large patterns (up to a maximum size of 2^32 by 2^32 (2^32 = 4,294,967,296)). The best demonstration of this is the "breeder.life" patterns, which all grow at an ever increasing rate. On a fast computer, these patterns rapidly become *very* large.

From the Xlife distribution:

OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

## 1.4 Running AXlife

The most important thing you need to run AXlife is memory, and plenty of it. AXlife will not load unless you have about 850K of free memory, and as a pattern grows more memory is consumed. This is due to the method used to calculate the next generation, which involves a huge lookup table. For large patterns, this is by far the most efficient approach. AXlife requires asl.library and, to be able to access the online help, amigaguide.library. AXlife will also try to use textfield.gadget to allow editing of comments. If this file cannot be found, comments can only be viewed.

AXlife can take several arguments from the Shell or as ToolTypes in its icon. In either case, the format is identical. The arguments are:

PUBSCREEN=<pubscreen name>

Specifies that AXlife is to open on the named public screen, e.g. PUBSCREEN=PowerPacker. If the screen is not available AXlife falls back onto the default public screen. Note that the name of a public screen is case sensitive.

FILREQ=<left/top/width/height>

Specifies the position and size of the file requester used for loading and saving life patterns., e.g. FILEREQ=0/0/320/200. Out of range values are ignored. If a value is negative, then the default value will be used, e.g. FILEREQ=-1/0/-1/200 causes the requester to be 200 pixels high and start at the top of the screen, but with the default width and left position.

HIDE

Enables the "Hide Cells" item of the Options menu.

STATUS

Enables the "Show Status" item of the Options menu.

CELLS

Enables the "Cell Count" item of the Options menu.

CLROPEN

Enables the "Clear on Open" item of the Options menu.

MAG

Specifies the magnification to use, i.e. MAG=n, where n is one of 1, 2, 4, 8, or 16. When AXlife is running, the magnification is controlled by the "Magnification" sub-menu of the Options menu.

## 1.5 Controlling AXlife

The following menus are available in AXlife:

Project
Cells
Options

The centre of the displayed area can be chosen by clicking on the desired new centre square with the left mouse button. Also, pressing the <Return> or <Enter> keys causes the next generation to be calculated and displayed (i.e. single-step). The numeric keys of the keypad have the following functions assigned to them:

```
7: Move centre of      8: Move centre of      9: Move centre of
   displayed area         displayed area         displayed area
   up and left.           up.                    up and right.

4: Move centre of      5: Centre display on   6: Move centre of
   displayed area         weighted centre        displayed area
   left.                  of the pattern.        right.

1: Move centre of      2: Move centre of      3: Move centre of
   displayed area         displayed area         displayed area
   down and left.         down.                  down and right.
```

Finally, pressing the "Help" key gives access to the online help. If a menu is currently selected, then this help file will open on the appropriate section for that menu.

## 1.6 Project Menu

Open A file requester opens to allow selection of a life pattern to be loaded. If the file format is relative, then the file will be loaded relative to the spot (see the "Set Spot" item in the Options menu). If the "Clear on Open" item of the Options menu has been selected, then the life pattern currently in memory will be lost, otherwise the new pattern will be overlayed on the current one.

Save As A file requester opens to allow the selection of a name to save the current pattern under. Any information in the "Comments" requester will also be saved. If the file already exists, a requester will appear to confirm the overwriting of the file.

Comments A window opens which contains information about the current pattern, namely a descriptive name for the pattern (which is unrelated to the name the file is saved as), the owner of the pattern, and any comments. All these can be

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   edited by clicking on the appropriate gadgets (for more
   information on the keys available while editing comments,
   see textfield.gadget).

Help     If amigaguide.library is available, displays this help
   file.

About    Some information about AXlife.

Quit     Quits AXlife. Any unsaved patterns will be lost.
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## 1.7 Cells Menu

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Clear    Clears the current life pattern from memory, leaving an
   empty life plane.

Randomize  Fills the area of the life plane on display with a random
   pattern of live cells. Due to the way AXlife works, such
   random patterns are very inefficient and will take a long
   time to generate.

Centre   Centres the displayed area on the weighted centre of the
   complete pattern. The "5" key on the numeric keypad has
   the same function.

Generate   If this is checked, generations are calculated
   continuously. If not, no calculating is done.

One Generation If the "Generate" option is not checked, this will cause
   a single generation to be calculated and displayed,
   giving a single-step method to observe the evolution of
   a pattern. This can also be acheived by pressing either
   of the <Return> or <Enter> keys.

New Rules  The default rules for life are 23/3, which means that a
   cell stays alive if surrounded by 2 or 3 neighbours, and
   that a cell is reborn if surrounded by 3 other cells. If
   you wish to try different rules, enter the new rules in
   the string gadget and press <Return>, or click on
   "Accept". The format must always be numbers representing
   the possible numbers of neighbours when a cell stays
   alive, a forward slash (/), and then numbers representing
   when a cell will be reborn.

Benchmark  This gives an indication of the raw speed of the life
   generation engine. Enter the number of generations to time
   over in the gadget and press <Return>, or click on "Time".
   The generations will be calculated, but not displayed, as
   displaying the pattern can use up a lot of cpu time (see
   "Hide Cells" in the Options menu). When this is complete,
   a requester will appear giving the total time taken and
   the average generation rate.
```

## 1.8 Options Menu

Edit Mode  If this options is selected, the current pattern can be edited. When the mouse pointer is over a specific cell, clicking the left mouse button puts a live cell at that point, while clicking the right mouse button clears the cell (i.e. puts a dead cell). Note that in this mode the menus are disabled (so that the right mouse button can be used for cell editing), but keys are still functional. Edit mode can be exited by pressing the <Esc> key.

Hide Cells   The computer can spend almost all its time updating the display rather than calculating the next generation. If it is required that the generation engine runs as fast as possible, select this option to avoid redrawing the display. When this option is deselected, the pattern will reappear. On a fast machine with this switch on, AXlife runs *extrememly* quickly.

Show Status  If selected, AXlife to print the number of generations and of boxes (the generation engine treats the entire pattern as composed of 8x8 boxes) in the window title bar.

Cell Count   If this and the above "Show Status" options are selected, then in addition to printing the number of generations and boxes, AXlife will print the total number of live cells for each generation. Note that this requires further calculation and will cause a noticeable drop in generation speed.

Clear on Open  If this option in selected, then the current pattern is erased before a new pattern is loaded (via the "Open" item in the Project menu).

Set Spot   Initially, relative files are loaded relative to the centre of the display. If this item is selected, clicking the left mouse button sets the spot to a new position, and pressing <Esc> leaves this mode without setting the spot. If the display is cleared or centred then the spot is reset to the centre of the display.

Magnification  This submenu determines the size of each cell on screen. If 1 is selected, then each cell is represented by a single pixel; if 2 is selected, then each cell is represented by a 2x2 square; if 4 then by a 4x4 square, and so on.

## 1.9 Life File Format

Life patterns are stored as ASCII files. A line beginning with a hash (#) has a special meaning, depending on the next character:

#N    The rest of the line is the descriptive name of the file, which is not related to the actual file name the file is stored as.

#O The rest of the line gives the owner of the file.

#C The rest of the line is a comment (see the "Comment" item in the
or #D Project menu).

#A This specifies that the data is in absolute xy coordinate pairs, each pair specifying an active cell in the pattern. The data is absolute in the sense that the loaded pattern appears in the same place relative to the display as when it was saved.

#R This specifies that the data is in relative xy coordinate pairs, each pair specifying an active cell in the pattern. The data is loaded relative to the spot (see the "Set Spot" item in the Options menu). The data can be offset by a coordinate pair which optionally follows the #R, e.g. #R 10 11.

#P This specifies that the data is stored in picture format, with an asterisk (*) representing a live cell and any other character an empty cell. The data is loaded relative to the spot, as above. The data can be offset by a coordinate pair which optionally follows the #P. A file can contain more than one picture element, each with its own #P.

#I The rest of the line specifies a file to be included, so that Life patterns can be nested. Beware of including patterns not in the same path as the parent pattern, as path conventions differ between the Amiga and UNIX (This does not occur in any of the supplied patterns). The data can be offset by a coordinate pair which optionally follows the #I.

It is not necessary for a file to contain all (or indeed any) of the above. If non of #A, #R or #P are specified, #A is assumed.

## 1.10 History

1.0 * First release.

1.1 * New "Help" menu item to call up this file.
* Pressing the "Help" key now also brings up this file. If a menu is selected when the "Help" key is presses, help on that menu is displayed.
* Better SysIHack compatibility.
* If available, textfield.gadget is used to provide a multi-line string gadget for the "Comments" window.
* If the user attempts to save to a file which already exists, a requester appears to confirm the save.

If you have any comments, bug reports, etc. direct them to

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## 1.11 Asl Library

"asl.library" provides standard file and font requesters and is part of the normal Workbench 2.0+ distribution. It should be in the LIBS: directory of your boot disk or partition.

## 1.12 AmigaGuide Library

"amigaguide.library" provides support for displaying AmigaGuide® format documents and is part of the normal Workbench 3.0+ distribution. A version released by Commodore for earlier systems is available in the Fred Fish collection and on the Aminet archive.

## 1.13 TextField Gadget

"textfield.gadget" is a BOOPSI gadget which allows programs to use multi-line string gadgets. "textfield.gadget" is © 1994 Mark Thomas.

For Workbench 3.0 and higher, copy the file to SYS:classes/gadgets. Although Workbench 2.0 and 2.1 support the gadget, there is no standard place in the system to install it. It is suggested that you create a subdirectory "gadgets" in your LIBS: directory and copy it there. Alternatively, you can leave it with AXlife in the "gadgets" subdirectory.

While using the gadget, the following keys are available (reproduced from the "textfield.gadget" documentation):

Shift Cursor Up Move to the top line in the current page, or scroll up one page if cursor is on the top line.

Shift Cursor Down Move to the bottom line in the current page, or scroll down one page if cursor is on the top line.
Ctrl or
Shift Cursor Right  Move to the far-right end of the current line.

Ctrl or
Shift Cursor Left Move to the far-left end of the current line.

Shift Backspace Delete all the text to the left of cursor on the current line.

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    Shift Delete  Delete all the text to the right of the cursor
      on the current line, including the highlighted
      character.

    Ctrl Cursor Up  Move to the top line of the text.

    Ctrl Cursor Down  Move to the bottom line of the text.

    Alt Cursor Right  Move to the next word.

    Alt Cursor Left Move to the previous word.

    Alt Cursor Up Move to the first character in the gadget.

    Alt Cursor Down Move to the the last character in the gadget.

    Alt Backspace Deletes the word to the left of the cursor,
      starting at the current cursor position.

    Alt Delete    Deletes the word to the right of the cursor,
      starting at the current cursor position.

    Ctrl x    Deletes the whole line that the cursor is on.

    Right Amiga e Erase all text in the gadget, and store in the
      undelete buffer.

    Right Amiga v Paste text from the clipboard to the current
      cursor position.

    Right Amiga a Mark all text.

    Right Amiga u Undelete the last block of text marked, or
      recover from Right Amiga e.

  When text is highlighted the following keys are available:

    Delete or   Erase marked text (saved in the undelete buffer).
    Backspace

    Right Amiga x Cut marked text to the clipboard.

    Right Amiga c Copy marked text to the clipboard.

    Right Amiga v Replace marked text with text from the clipboard
      (saving marked text in the undelete buffer).

    Any text key  Replace marked text with that character.
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