

# **AXlife**

David Kinder

**COLLABORATORS**

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WRITTEN BY	David Kinder	January 18, 2023	

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# Chapter 1

## AXlife

### 1.1 AXlife Guide

AXlife 1.2                      Based on Xlife 2.0  
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About Life  
Xlife and AXlife  
Running AXlife  
Project Menu  
Cells Menu  
Options Menu  
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History

### 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 referred to as a generation. Each new generation depends only on the previous generation. Given a generation,

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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,  
October 1970 and February 1971.

### 1.3 Xlife and AXlife

AXlife is based on Xlife, the definitive life program, which runs under Unix X-Windows. AXlife incorporates an Amiga-specific interface, but the 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:

XLife Copyright 1989 Jon Bennett jb7m+@andrew.cmu.edu, jcrb@cs.cmu.edu

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## 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 around one megabyte 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 either

```
asl.library
or
reqtools.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, 16, -2, -4 or -8. Positive magnification values indicate zooming in, negative ones zooming out. When AXlife is running, the magnification is controlled by the "Magnification" sub-menu of the

Options menu. On the menu, 1/2 corresponds to `MAG=-2`, 1/4 to `MAG=-4`, and so on.

#### BORDER=<RIGHT|BOTTOM>

Controls which border the window sizing gadget appears in. The default is the right border.

#### REQTOOLS

Causes `reqtools.library` to be used for all requesters. This can be useful as, unlike the Asl file requester, ReqTools buffers the current directory.

#### COORDS

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

---

## 1.5 Mouse and Keys

The centre of the displayed area can be chosen by clicking on the desired new centre square with the left mouse button. The following keys can be used in AXlife. The first group of keys can also be used in edit mode.

```

<Return>, <Enter> or 'o'   Perform a single generation.
Keypad 1                   Move centre of display down and left.
Keypad 2                   Move centre of display down.
Keypad 3                   Move centre of display down and right.
Keypad 4                   Move centre of display left.
Keypad 5                   Centre on pattern.
Keypad 6                   Move centre of display right.
Keypad 7                   Move centre of display up and left.
Keypad 8                   Move centre of display up.
Keypad 9                   Move centre of display up and right.

<Help>                     Display online help. If a menu is selected
                           when <Help> is pressed, the appropriate
                           help page is opened.
'=', '+'                   Increase magnification by a factor of 2.
'-'                         Decrease magnification by a factor of 2.
                           Unlike the 'Magnification' menu item,
                           which only goes as low as 1/8, this key
                           can be used to go as low as 1/64.
'g'                         Toggle continuous generation.
'c'                         Toggle display of cell count.
'h'                         Toggle redrawing of display.
'l'                         Bring up file requester to load a file.
'S'                         Bring up file requester to save pattern.
'!'                         Fill display with random pattern.
'R'                         Change life rules.
'B'                         Open benchmark window.
'V'                         Open comments window.
'C'                         Clear life plane.
'?'                         Show 'About' requester.
'Q'                         Quit AXlife.

```

## 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 origin (see
the "Set Origin" 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 overlaid 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 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.

## 1.7 Cells Menu

**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 achieved 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, or by pressing both mouse buttons.

**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 is selected, then the current pattern is erased before a new pattern is loaded (via the "Open" item in the

Project menu).

**Set Origin** Initially, relative files are loaded relative to the

centre of the display. If this item is selected, clicking the left mouse button sets the origin to a new position, and pressing <Esc> leaves this mode without setting the origin. If the display is cleared or centred then the origin is reset to the centre of the display.

**Show Coords** When this option is selected, the current co-ordinates of the mouse pointer on the life plane are shown in the window title bar. The co-ordinate origin is that defined above by the "Set Origin" option. Co-ordinates are always displayed when in edit mode.

**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. For fractional magnifications (e.g. 1/2), each pixel represents more than one (in this example, 4) cells. If any of the cells are active, the pixel appears filled.

## 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 origin (see the "Set Origin" 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 origin, 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.

1.2 \* Fractional magnifications (1/2, 1/4, 1/8, ...) now available.

\* Completely SysIHack compatible.

\* The diagonal movement keypad keys are now truly diagonal, i.e. equal movement in the x and y directions. This makes following gliders much easier.

\* Pressing both mouse buttons simultaneously leaves edit mode.

\* "Set Spot" menu item renamed to "Set Origin".

\* Magnification now takes the centre of the display as its origin.

\* Window is no longer redrawn if it is moved.

\* Origin is only reset on clearing life plane.

\* Sizing gadget can be in either right or bottom border.

\* If desired, reqtools.library can be used for requesters.

\* Many of the Xlife keys supported.

\* Co-ordinates can be displayed in the window title.

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

kinder@teaching.physics.ox.ac.uk

or david.kinder@physics.ox.ac.uk

I can also be reached (eventually) at

2, Clwtt Cottages,

Bangor Road,

Gyfelia,

Clywd.

LL13 0YL

U.K.

## 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 ReqTools Library

"reqtools.library" provides a set of requester routines enhanced over those available from the system libraries. "reqtools.library" is © 1991-94 Nico François.

## 1.13 AmigaGuide Library

"amigaguide.library" provides support for displaying AmigaGuide® format documents and is part of the normal Workbench 3.0+ distribution. A version has also been released by Commodore for earlier systems.

## 1.14 TextField Gadget

"textfield.gadget" is a BOOPSI gadget which allows programs to use multi-line string gadgets. "textfield.gadget" is © 1994-95 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.

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

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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