Introduction to OSXLCU21 System

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Abstract
This paper describes each one of the parts of OSXLCU21 system, the main feature of this application is the panel of gliders which allows to reproduce any binary collisions among them. The system is implemented with the idea of providing an useful and easy enviroment to the user for studying and realizing experimentation in the analysis of Rule 110.
1 OSXLCAU21 System

The OSXLCAU21 system is developed in order to satisfy the necessity of a detailed study in the evolution space of Rule 110, this system is coded in C-Objective and at the moment it is available for OPENSTEP, Mac OS X and Windows operating systems (the version for Windows needs the installation of the WebObjects system for Windows).

![Info OSXLCAU21](image)

Figure 1: OSXLCAU21 System

The use of the OSXLCAU21 system is not complicated, the interface is dominated by buttons and windows. The system is able to work with all the evolution rules of order (2, 1). Nevertheless the handling of gliders is only for Rule 110; the system is still in developing process but it suitably works for illustrating the use of the phases and reproduce several complex behaviors.

Next we describe the facilities offered by the system and the operations that can be realized with them. The three versions of the system use the same original environment of OPENSTEP. The system and its source code are of public domain and can be freely downloaded from [3].

2 Main panel OSXLCAU21 window

The Main panel OSXLCAU21 window is the one which controls most of the actions of the system and provides useful information. The NSTextField object evolution rule allows to edit directly the evolution rule that we desire to visualize; the rule is introduced in decimal notation, taking values from 0 up to 255. The NSSlider object density allows to define the density of the configuration initial, a density close to zero means that state 0 will occupy most of the cells in the
configuration initial, in the opposite case state 1 dominates. This density can
be directly introduced in its NSTextField whether an exact density is desired.
For instance, Rule 110 finds its statistical stability approximately in 0.57,
hence this value can be directly introduced in the initial density.

![Figure 2: Panel main](image)

The object size cell allows to define different sizes in which the cells can be
seen in the evolution space, the rank of the different sizes goes from 1 up to 10.
This feature is useful when we desire a better visualization of both a particular
collision or a given structure.

The object cells shows the number of cells in the configuration initial and
the object gen presents the number of calculated generations, these values are
updated whenever the user defines a new size in the window presenting the
evolution.

The NSButton object configuration initial assigns a random initial config-
uration according to the density and the colors defined at this time. The button
evolution calculates and shows the evolution from the currently defined initial
configuration. The evolution is drawn in each line.

The button continue evolution calculates and shows the continuation of the
previous evolution from the last generation of the first evolution. Each time
we continue with the evolution, the number of generations is also updated in
the NSTextField gen. The button clear view cleans the evolution space and
initializes all the variables of the system. The button paint ether colors the
T3 mosaic in other colors defined by the user, this feature is useful to get a
better visualization of single gliders or complex collisions between several gliders
against the periodic background.

The NSMatrix objects space and no-space establish a small division between
each one of the cells, this is useful when the user wants a detailed view of the
number of cells involved in a given sequence or region.
3 Evolution window

The evolution space is controlled by a NSView object assigned to the Evolution window, the window is resizable over all the screen. One current and important problem in the system is that the initial configuration is limited by the resolution of the screen.

Another relevant detail is that the system does not determine the size of the configuration introduced by the user, producing undesired structures in the limits of the configuration. In order to avoid these undesired structures in the evolution, one alternative is to fit manually the width of the Evolution window so that the regular expression defining ether finishes precisely in the last cell.

![Evolution space](image)

**Figure 3: Evolution space**

Figure 3 shows three evolutions in Rule 110, the first illustrates the evolution from a random configuration, in this example we have applied different colors to ether in order to get a better identification of the gliders or simply to obtain an attractive figure.

The second figure illustrates the evolution of a cell with state 1, this example is interesting because if the space is sufficiently large, it is possible to see how the produced margin also generates gliders gun, and in four thousand generations the evolution becomes periodic.

The third figure in a special case illustrating the construction of B² glider. Two ether configurations are assigned using the panel of gliders, then an A glider in phase 2 is specified. The location of gliders and phases in the panel of gliders is by means of coordinates, first the user looks for the row of the A glider, then the user takes the column corresponding with phase 2 and this selection assigns the desired sequence, this process is used to yield the whole expression. In this
example it is necessary to extract sequences which are not specified in the panel of gliders, for instance the group of A and B gliders must be assigned from the chain console. The reason of this problem is because the regular expressions are coded for a single glider and not for groups or extensions of them. In this case we have another problem due to the unlimited number of times in which they can be grouped or extended.

4 Matthew Cook Gliders window

The main feature of this program is the panel of phases for each glider in Rule 110, this panel corresponds with the classification established by Matthew Cook. If we want to introduce a particular phase, we just need to click in the button of the desired phase and the adequate fragment of configuration is immediately assigned and drawn in the Evolution window. This panel contains all the phases $f_{-1}$ for every glider including the glider gun.

![Matthew Cook Gliders window](image)

Figure 4: Panel of glider phases
Sometimes we can make a mistake at the moment of introducing the phase, in order to solve this problem we use a delete string button which deletes the last introduced chain in the configuration. One problem here is that the system does not save the constructed configuration.

5 Color Panel window

The colors for the states of the cellular automaton may be controlled with the Color Panel window, when we desire to paint ether using different colors we can define them for each state of the T3 mosaic. The color wells invoke automatically to the Colors panel when we click them, this feature is a unique advantage of the NeXTSTEP system.

![Colors Panel](image)

Figure 5: Panel’s of colors

There is a wide range of color combinations offered by this panel, including both the PANTONE and PANTONE Process classification in the case of NeXTSTEP and OPENSTEP systems, which in addition have all their outputs in PostScript.

6 Console Strings window

At the time of experimenting the construction of certain configurations, we have to define chains which require precise manipulation, for example groups of gliders which cannot be constructed neither by means of phases or extensions nor from the configuration initial.

In order to solve this problem there is a small console which is able to receive a particular chain and assign it to the initial configuration clicking the corresponding button.
Figure 6: Panel of strings

Figure 6 shows the chain console, it has a simple form but it is very useful as well. The desired chain is introduced in the object input string, this one can support up to 1500 elements. Once we have typed the chain, the user must press the button set string, then the chain is presented in the lower part of the console to verify if it has been correctly interpreted and the chain is immediately drawn in the evolution space. If the introduced chain is not the desired one for some reason, the user can return to the Matthew Cook Gliders panel and delete the chain with the button delete string.

7 Conclusions

In conclusion the OSXLCAU21 system has yet several limitations such as:

- Controlling the evolution and stopping it at any desired moment.
- Creating a BrowserView which allows to manipulate evolutions of larger dimensions.
- Editing directly some wished configuration in the evolution space or if the space is full, then we can obtain an automatic update of the evolution with regard of the new introduced cell [1].
- Creating zoom-in and zoom-out features of visualization.
- Introducing matrix tools for making analysis of graph theory and probabilities [2].
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References

