

# CLLAUS – THE CELLULAR AUTOMATA SIMULATOR

## USER'S GUIDE

VERSION 1.0

### INTRODUCTION

*Cellular automaton* is a discrete model consisting of a regular grid of cells, which can be any finite number of dimensions. Time is also discrete, thus the state of a cell at time  $t$  is a function of the states of finite number of cells (called its neighbourhood) at time  $t - 1$ . The *neighbourhood* is a constant selection of cell positions relative to specified cell (which either might or might not be in its own neighbourhood). Automaton evolves to its next generation once the *transitional function* is simultaneously applied to each cell in the grid.

*Conway's Game of Life* is a special cellular automaton described by mathematician John Horton Conway in Scientific American (October 1970). The universe of the Game of Life is an infinite two-dimensional rectangular grid of square cells, each of which is in one of two possible states, *live* or *dead*. The neighbourhood of each cell consists of 8 cells, which are directly horizontally, vertically and diagonally adjacent. Transitional function between two generations is application of two simple rules. First rule says that any live cell with two or three live cells in its neighbourhood survives to the next generation or else dies. Second rule says that any dead cell with exactly three live cells in its neighbourhood returns to life in the next generation or else remains dead.

### SPECIFICATION

Program *cllaus*, as an acronym for *cellular automata simulator*, currently implements so called Conway's Game of Life automaton. If there would be any future version, there could be more automatons implemented. Primary goal of program is to provide real time resizable view of evolving universe, which can be easily zoomed and scrolled by mouse or keyboard. Program is able to load quite large patterns since it can address over  $4 \cdot 10^9$  cells in each dimension, although very large patterns are CPU and memory intensive and the simulation is thus slower. Simulation can be accelerated by turning off universe rendering.

User interface offers some basic features such as simulation control, speed adjustment or file handling. Simulation can be started and stopped. It is also possible to step only one generation forward. Patterns can be loaded from or saved into RLE files, which is at this time only supported file format. In current version it is not possible to interactively edit patterns via user interface. Visible area of the universe can be saved into BMP, PNG or JPG image.

### CONTROLS

In order to load pattern into the universe, click on *Load* button and locate the file in opened dialog. Once the pattern is loaded into universe the simulation can be started by clicking on *Start* button. While the simulation is running the speed of evolution can be adjusted by shifting the slider in the bottom right corner to the right (faster) or to the left (slower). Number which is located under the slider represents how many generations were computed until now. To make simulation running even faster it is possible to temporarily turn off animation by *Animation* checkbox. Note that when certain speed limit is exceeded the frame dropping feature takes effect in order to speed up evolution. However if there is very large pattern loaded, due to which the simulation is slow even at maximum speed, frame dropping can be inconvenient. Therefore it can be turned off by *Dropping* checkbox. Evolution can be paused any time by clicking on *Stop* button.

When the simulation is paused current state of universe can be captured into file by clicking on *Save* button. In order to save current view of the universe into image file click on the *Snapshot* button. If you want to step only one generation forward just click on *Step* button while the simulation is not running. Paused simulation can continue to evolve current state of the universe by clicking on *Start* button again. If you want to replace current pattern by some different pattern just click on *Load* button and choose new file to open.

View of the universe can be interactively adjusted by zooming and scrolling. Zoom function is realized by steering mouse wheel or by pressing plus/minus keys. Scroll function is realized by dragging and dropping the mouse or by pressing arrow keys.



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