Cellular Automata and their Application to Generative Image Processing Tasks

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# Introduction

Cellular automata are mathematical idealizations of physical systems in which space and time are discrete, and physical quantities take on a finite set of discrete values. A cellular automaton consists of a regular uniform ***lattice*** ( or ***array***), usually extending infinitely with discrete variable at each ***site*** (or ***cell***). The ***state*** of a cellular automaton is completely specified by the values of the variables at each site. A cellular automaton evolves in discrete time steps, with the value of the variable at one site being affected by the values of variables at sites in its ***neighborhood*** on the previous time step.

# References

[1] [Statistical Mechanics of Cellular Automata, Stephen Wolfram, 1983](https://github.com/dimitarpg13/dynamical_systems_and_ergodicity/blob/main/literature/articles/cellular_automata/statistical-mechanics-cellular-automata.pdf)

[2] [Two Dimensional Cellular Automata, Norman Packard, Stephen Wolfram, 1984](https://github.com/dimitarpg13/dynamical_systems_and_ergodicity/blob/main/literature/articles/cellular_automata/two-dimensional-cellular-automata.pdf)

[3] [Computation Theory of Cellular Automata, Stephen Wolfram, 1984](https://github.com/dimitarpg13/dynamical_systems_and_ergodicity/blob/main/literature/articles/cellular_automata/computation-theory-cellular-automata-Wolfram-1984.pdf)

[4] [Universality and Complexity in Cellular Automata, Stephen Wolfram, 1984](https://github.com/dimitarpg13/dynamical_systems_and_ergodicity/blob/main/literature/articles/cellular_automata/universality-complexity-cellular-automata-Wolfram-1984.pdf)

[5] [New Kind of Science, Stephen Wolfram, 2002](https://github.com/dimitarpg13/dynamical_systems_and_ergodicity/blob/main/literature/articles/cellular_automata/Stephen_Wolfram-A_New_Kind_of_Science-Wolfram_Media_2002.pdf)

[6] [A Comprehensive Taxonomy of Cellular Automata, Michiel Rollier et al, 2024](https://github.com/dimitarpg13/dynamical_systems_and_ergodicity/blob/main/literature/articles/cellular_automata/A_Comprehensive_Taxonomy_of_Cellular_Automata_Rollier_2024.pdf)

[7] [Reliable Cellular Automata with Self-Organization, Peter Gacs, Boston U., 2024](https://github.com/dimitarpg13/dynamical_systems_and_ergodicity/blob/main/literature/articles/cellular_automata/Reliable_Cellular_Automata_with_Self-Organization_Gacs_2024.pdf)