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Boundary growth in one-dimensional cellular automata

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(Submitted on 10 Apr 2012)

We systematically study the boundaries of one-dimensional, 2-color cellular automata depending on 4 cells, begun from simple initial conditions. We determine the exact growth rates of the boundaries that appear to be reducible. Morphic words characterize the reducible boundaries. For boundaries that appear to be irreducible, we apply curve-fitting techniques to compute an empirical growth exponent and (in the case of linear growth) a growth rate. We find that the random walk statistics of irreducible boundaries exhibit surprising regularities and suggest a threshold separating two distinct classes. Finally, we construct a cellular automaton whose growth exponent does not exist, showing that a general classification by exponent is not possible.

Comments: 31 pages, 10 figures

Subjects: **Cellular Automata and Lattice Gases (nlin.CG)**; Discrete Mathematics (cs.DM); Combinatorics (math.CO)

MSC classes: 68Q80, 68R15, 82C41

Cite as: **arXiv:1204.2172v1 [nlin.CG]**

Submission history

From: Eric Rowland [[view email](#)]

[v1] Tue, 10 Apr 2012 14:58:02 GMT (743kb,D)

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