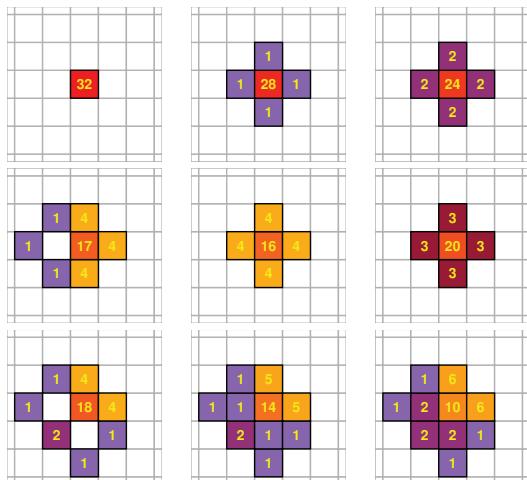


## About the Cover

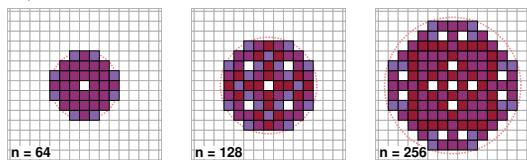
### Sandpile

This month's cover theme is taken from this issue's article "What is a sandpile?" by Lionel Levine and James Propp. A sandpile associated to the 2D lattice  $\mathbb{Z}^2$  is a simple cellular automaton. At any moment is given a function  $f(i, j)$  on the lattice, non-zero at only a finite number of points. A point  $(i, j)$  at which  $f(i, j) \geq 4$  is selected. The function at  $(i, j)$  is decremented by 4, and the value at each of its 4 neighbors is incremented by 1. This is called *toppling* the sandpile at  $(i, j)$ . In general, one toppling may lead to an avalanche, but the process will eventually reach a stable state with no more topplings possible. Here are the first 9 steps of the process on the cover, which starts out with an initial value of  $n = 32$  at the origin.



Here, as on the cover, this is to be read in boustrophedon mode, alternating left-to-right and right-to-left from one row to the next. The selection criterion in this example was lexicographic, but in fact this sandpile is *abelian*, which means that the state after  $n$  steps depends only on the set of nodes toppled, not the order in which they are toppled.

As the article by Levine and Propp mentions, and as it is with many cellular automata (my favorite is Langton's ant) it is the conjectural large-scale and/or long-term behavior of sandpiles that fascinates the physicist, who see them as simple examples of behavior near critical points. The conjectured scaling behavior shows up weakly in the growth of the diameter, even for small  $n$ .



I have found useful "The abelian sandpile; a mathematical introduction" by Ronald Meester, Frank Redig, and Dmitri Znamenski, which can be found at [www.cs.vu.nl/~rmeester/preprints/sandpile.ps](http://www.cs.vu.nl/~rmeester/preprints/sandpile.ps)

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