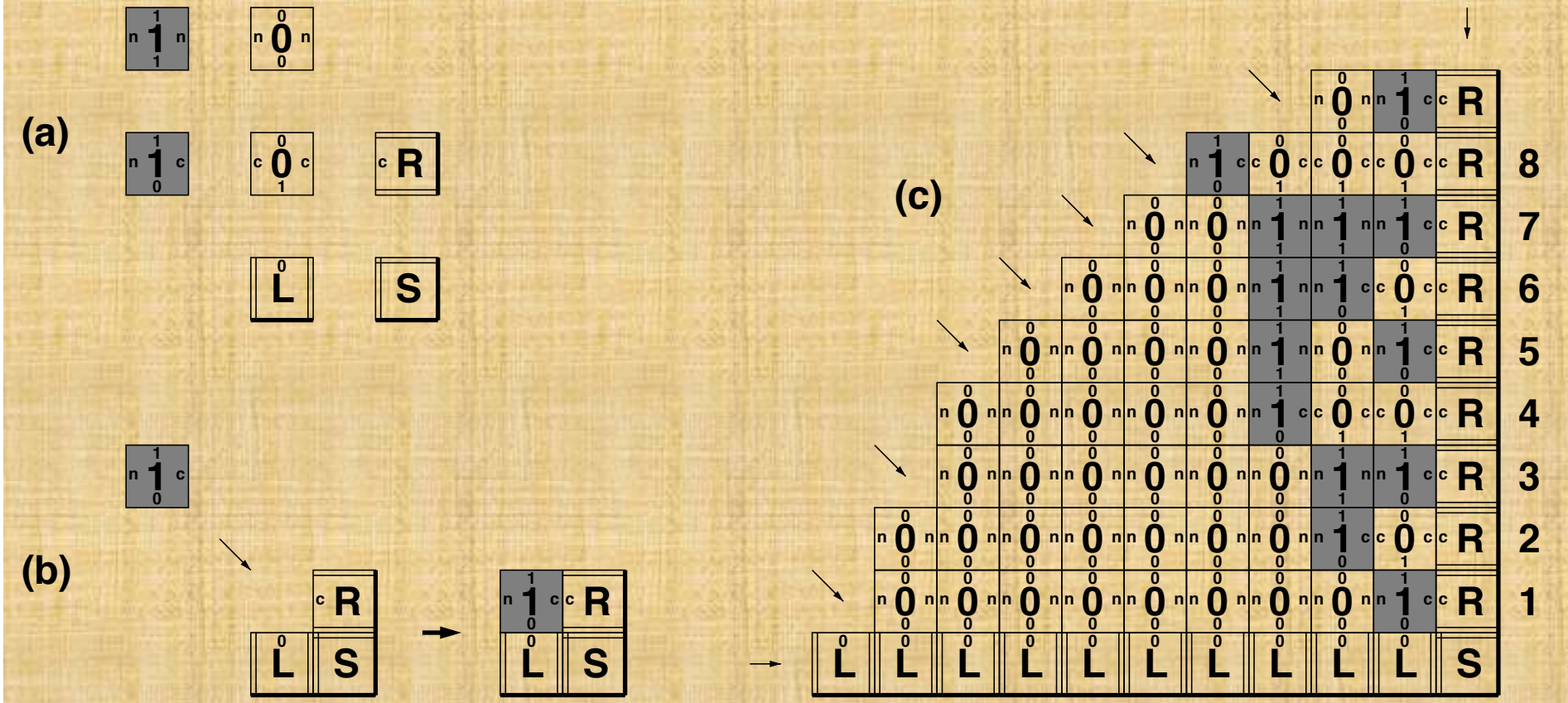
Self-Assembled Circuit Patterns

from DNA9 Conference paper by Cook, Rothmund, Winfree

Assembly of a Counter via Tiling



The set of seven tiles shown in (a) are a Tile Assembly Model program for counting in binary. The tiles labeled "1" are colored gray to make it easier to see the resulting pattern, visible in (c). The self-assembly progresses by individual tiles accreting to the assembly as shown in (b). Edges marked with a small letter or number have bond strengths of 1, while edges with a double line have bond strengths of 2 (and do not require a further label here, since there is only one vertical and one horizontal kind). A later stage of self-assembly is shown in (c), with arrows indicating all the places that a new tile could accrete.

Assembly of a Demultiplexer via Tiling

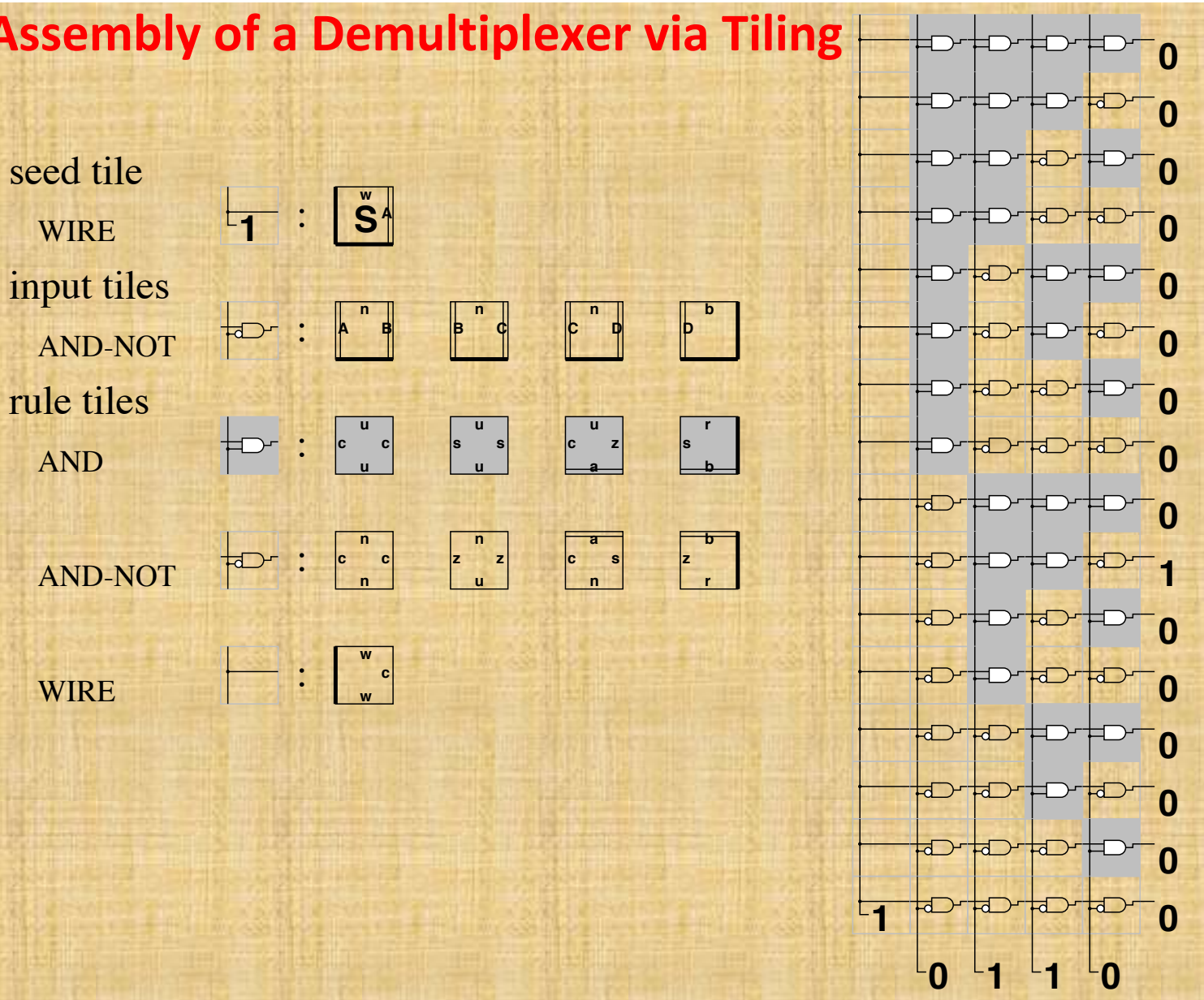


Fig. 2. Using a binary counter to self-assemble a demultiplexer. Logic levels for an example input-output pair are shown: only the row that exactly matches the input pattern is set to "1". To make a pattern with N rows, $10 + \log N$ tiles are used.

Assembly of two Demultiplexers via Tiling

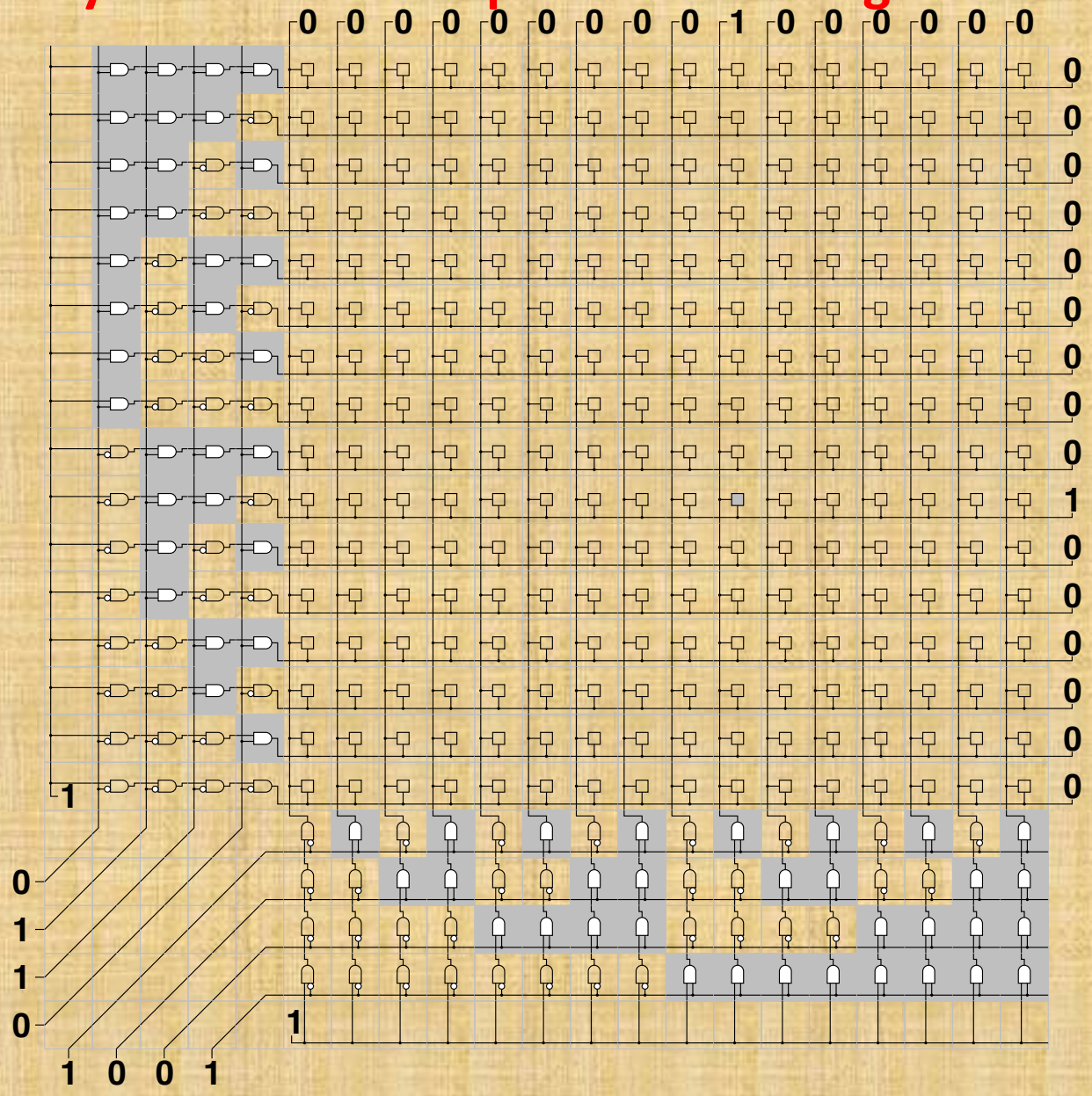


Fig. 3. Two self-assembled demultiplexers at right angles can address a memory. The gray memory cell is being addressed in this figure.

Assembly of Sierpinski Triangle (mod 2 Pascal Triangle) via Tiling

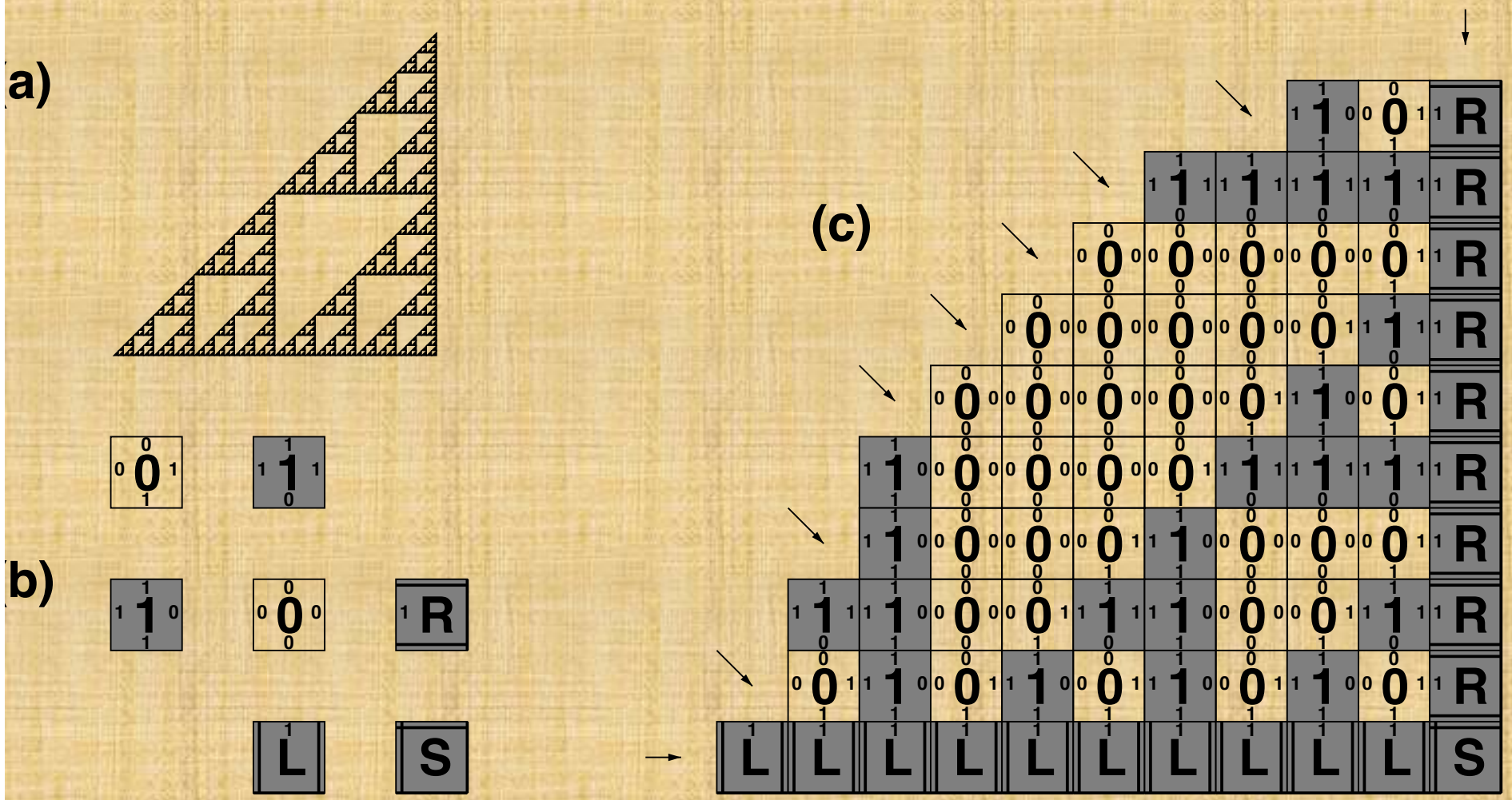


Fig. 4. The Sierpiński triangle and a set of tiles that construct it in the limit.