Lecture notes for CME352 Molecular Algorithms. February 3rd.

Tile transformations Cellular automator. State transition function, the state of T is a function of its neighbors S_1 through S_4. Self assembly can be obtained by adding a time dimension. Binary counter is an example of this.

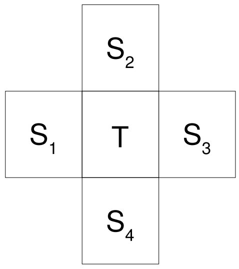

Figure 1: Cellular automator principle.

Resolution loss Resolution loss is a problem because we need to replace each tile in the system by a kxk system of proofreading tiles. This beats the purpose of growing nanoscale structures. We let $n(k)$ be the number of distinct aligned blocks of size k aligned at positions that are a multiple of $k = 2^i$. We have at most 4 distinct kxk-blocks in a Seirprinski block. Each block can be thought of as a snake proofreading block because all the tiles are unique, so we need $4k^2$ tiles per block. In this case we have no resolution loss, because each block has the same size even with snake proofreading. Thus we can implement proofreading without resolution loss at the cost of having more distinct tiles.

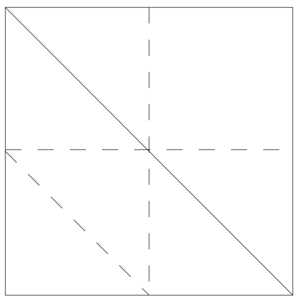

Figure 2: Seirprinski triangle. Each sub-triangle is constructed identically to its parent.

Dimension Augmentation Put the proof reading into a third dimension. There are indications that it is physically possible to model tile assembly in three dimensions. However, it collapses on itself if it is attached to a 2D structure, therefore it needs to be kept in solution, which is still an open problem. Thus it has not been posible to image 3D structures yet.

Odd and even duplicates. Number each tile odd or even. Even and odd tiles cannot be adjacent to tiles of their own parity. Then duplicate plane k times in a third dimension where even tiles grow outwards and even inwards. All tiles have glues with strength one in the third dimension (outwards and inwards). Only the even tile in the first layer have a strength two glue, such that it can attach without help from the third dimension. Thereafter the even column can grow. The final even tile in the k'th layer has a stength two glue towards where we want to grow the odd column. For errors to grow in the bottom layer we need errors to form for all k layers, before the odd column can start to grow. Unfortunately there is no error analysis of this kind of system yet.

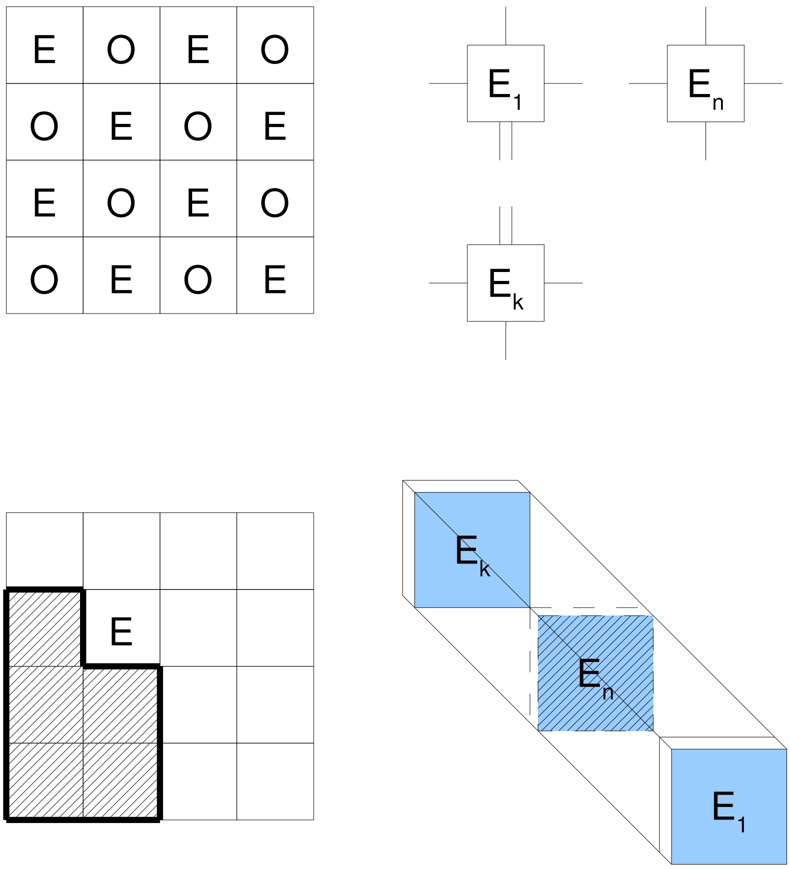

Figure 3: Dimension augmentation checker-board configuration together with illustration of even tile system. Even and odd columns are grown perpendicular to the tile plane, and the bottom glues of the E tiles link downwards.