F Self-assembly

F.1 A pattern is said to be *dead* if it appears in no tiling of the whole plane. Find a dead pattern by the tile sets depicted on Fig. 2–4.

F.2 Show that any finite tile set which can form only non-periodic tilings can also form dead patterns.

A *self-assembly scheme* for a set of decorated polygonal tiles consists in giving a *weight* to each tile edge and a global parameter called *temperature*. Then, to form a pattern or a tiling of the whole plane, one first put a tile, then add other tiles one at a time so that, when a tile is added, the sum of the weigths of its edges whoses decorations match is greater or equal to the temperature. Process stops when no tile could be further added.

F.3 Which patterns do form the self-assembly scheme depicted on Fig. 7?

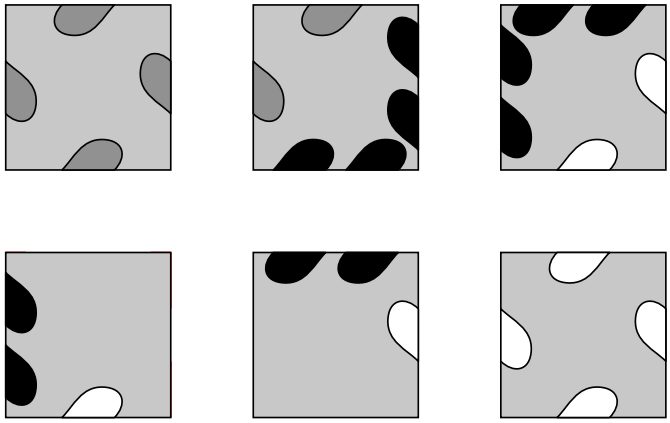

Figure 7: Self-assembly scheme at temperature 2, with the weight of an edge being the number of marks.

A general result states that, given a substitution over a tile set, there is a self-assembly scheme for this tile set such that tilings that can be assembled are exactly the hierarchical tilings associated with the substitution.

F.4 Can you find a self-assembly scheme for substitutions of Sections D or E?

G Alternating rhombi

G.1 Show that one can tile the plane with the notched square and rhombus of Fig. 8.

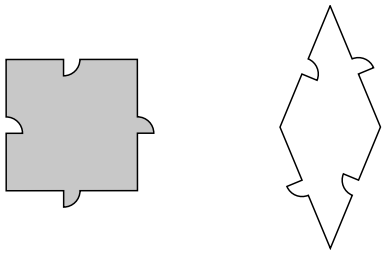

Figure 8: A grey square and a white rhombus (acute angle 45°).

G.2 Which tiling can you form that use as few as possible grey tiles?

G.3 Is it true that any tiling of the plane by the tiles of Fig. 8 is quasiperiodic?

G.4 Same questions with the two rhombi depicted on Fig. 9.

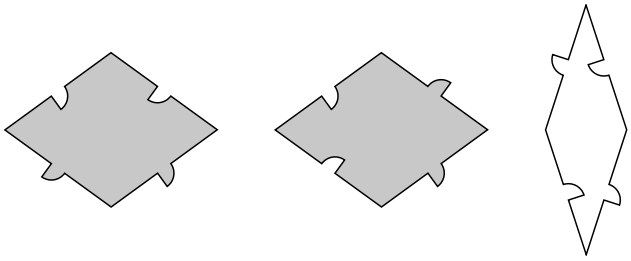

Figure 9: Two grey rhombi (acute angle 72°) and one white (acute angle 36°).