Assemblies in 2-Dimensional Confluent Temperature One Tile Assembly Systems

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Abstract

A confluent (deterministic) tile assembly system in two dimensions with non-cooperative binding (temperature one) has at most one maximal producible assembly, α_{max}, that can be viewed as a union of path assemblies. We prove that if α_{max} is not finite, then it must be either a 'grid' or a disjoint union of 'combs'. This result is obtained through a technique that we call *co-grow* of two paths, which is a superposition of two paths that produce a new path with desired properties. To a given α_{max} we can associate a finite labeled graph, called *quipu*, such that the union of all labels of walks in the quipu corresponds to α_{max}. The quipu implies that α_{max} is a union of semi-linear subsets of $\mathbb{Z}^2$ and we show that for each system the corresponding quipu can be algorithmically generated. These observations prove that a confluent temperature one tile assembly system cannot have universal computational power.

The full version of this work is available as [Durand-Lose et al., 2019].

Key-words. Tile assembly system; Directed (confluent) system; Non-cooperation; Ultimately periodic; Quipu; Universal computation.

References

Jérôme Durand-Lose, Hendrik Jan Hoogeboom, and Nataša Jonoska. Deterministic 2-dimensional temperature-1 tile assembly systems cannot compute. 50 pages, 2019. URL https://arxiv.org/abs/1901.08575.