

A new mathematical model for tiling with polyominoes

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September 19, 2019

Abstract

We present a new mathematical model for tiling finite subsets of \mathbb{Z}^2 using an arbitrary, but finite, collection of polyominoes. Unlike previous approaches that employ backtracking and other ‘brute-force’ techniques, our method is based on a systematic algebraic approach, leading in most cases to an underdetermined system of linear equations to solve. The resulting linear system is a binary linear programming problem, which can be solved via direct solution techniques, or via well-known optimization routines. We illustrate our model with some numerical examples computed in MATLAB. Users can download, edit, and run the MATLAB codes from:

https://people.sc.fsu.edu/~jburkardt/m_src/polyominoes/.

For larger problems we solve the resulting binary linear programming problem with an optimization package such as CPLEX, GUROBI, or SCIP, before plotting solutions in MATLAB.