

# Langton's flies

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## Abstract

Langton's Ant is an automaton defined over a two dimensional grid. Its movement is governed by the environment in a very simple way. We look for generalizations of Langton's ant to  $n$ -dimensional lattices. Remembering the different ways through which the ant was originally defined, we consider two approaches: the first comes from physics and the second from computer science. Two generalizations are proposed defining two families of dynamical systems. From the physics point of view, the ant is seen as a particle and hence it has no internal state other than its velocity. From the computer science point of view, the ant is viewed as an automata, and it has an orientation in space which we represent by an orthogonal basis. This constitutes the ant's internal state. We establish several facts about these automata. For example, we discover a whole family of automata whose movement is restricted to a sub-lattice of lower dimension. This observation complements previous results established for similar models. The 3-dimensional case is studied in detail. A total of thirteen transition rules is considered. Most of them are proved to have a simple behavior or to be similar to a 2-dimensional rule. For example, a certain particular rule is proved to be equivalent to the Langton's ant over the planar hexagonal grid. Some other rules are equivalent to the 2-dimensional Langton's ant. Only four rules produce trajectories which are 3-dimensional.

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