

Motivated by the problem of shape recognition by nanoscale computing agents, we investigate the problem of detecting the geometric shape of a structure composed of hexagonal tiles by a finite-state automaton robot. In particular, we consider the question of recognizing whether the tiles are assembled into a parallelogram whose longer side has length $w = f(h)$, for a given function f , where h is the length of the shorter side. To determine the computational power of the finite-state automaton robot, we identify functions that can or cannot be decided when the robot is given a certain number of pebbles.

In this talk, I will show that the robot can decide whether $w = ah+b$ for constant integers a and b without any pebbles, but cannot detect whether $w = f(h)$ for any function $f(x) = \omega(x)$. For a robot with a single pebble, I present an algorithm to decide whether $w = p(h)$ for a given polynomial p of constant degree. I will also point out some further results for having multiple pebbles.