

Evaluating a large class of Boolean circuits via algorithmic self-assembly of DNA strands

This talk will cover our recent theoretical and experimental work on designing and implementing a set of 356 self-assembling DNA strands, or single-stranded tiles, that implement any one of 2^{44} 6-bit Boolean circuits. The programmer first specifies a 6-bit input string encoded in a cylindrical-shaped DNA origami seed structure, then chooses a subset of 89 or more DNA tiles so that they begin attaching to the seed, self-assembling into a cylindrical nanotube lattice that evaluates a Boolean function as it grows. We show that this algorithmic growth process implements any one of a suite computations, such as bit copying, bit sorting, telling if an input string is a palindrome or represents a multiple of three in binary, randomised algorithms, cute patterns, leader election, and even simulation of the Turing-universal cellular automaton Rule 110. This work represents a significant increase in the complexity of algorithmic self-assembly systems that have been experimentally demonstrated to date.

Speaker: Damien Woods.

Joint work with David Doty, Cameron Myhrvold, Felix Zhou, Peng Yin and Erik Winfree.