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DNA nanostructures are opening up new research areas that require a wide breadth of knowledge, borrowing techniques from the fields of computer science, electrical engineering, biology, physics, and biochemistry. Since the self assembly of DNA strands occurs naturally at the molecular level, DNA nanostructures can be actualized autonomously. Thus, the physical limitations of top-down approach to photolithographic processes can be overcome.

The field of DNA computing began with the success of Leonard Aldeman’s experiment in 1994. In the experiment he solved a seven node instance of the Hamiltonian Graph problem (similar to the travelling salesman problem) with the use of DNA. The first step towards a DNA computer was achieved with the MAYA-I at Columbia University. MAYA-I which stands for Molecular Array of YES and AND/NOT logic gates, is composed of 23 logic gates and can play specific games of tic-tac-toe. MAYA-II has more than 100 logic gates and can play all forms of tic-tac-toe. Currently the major road blocks of the field is finding a viable means of integration of the DNA computer into current computing systems and the I/O of the DNA computer.

Nadrian Seeman and Baoquan Ding of New York University are using DNA nanostructures to create novel nanorobotic systems. Borrowing similar methods from the DNA computing field a 2-D lattice DNA array is actualized. When certain molecular inputs are placed in the system axial DNA strands can be made to swing in either of two directions. When this technology matures, the possibility arises to use these DNA nanorobotic arms to assemble structures (picostructures?) on the atomic level.

DNA computing is not set out to take over silicon based computing, but instead step into a field of computing that silicon based processors dare not stray – that of in situ fluids of a living organism. Considering the inputs to DNA computers are molecules, it makes since that scientists expect in the future to program DNA computers to react to certain molecules produced in diseased or cancerous cells by killing the cell before it can reproduce the mutation.

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