



11th Annual Conference on Foundations of Nanoscience: Self-Assembled Architectures and Devices (FNANO14)

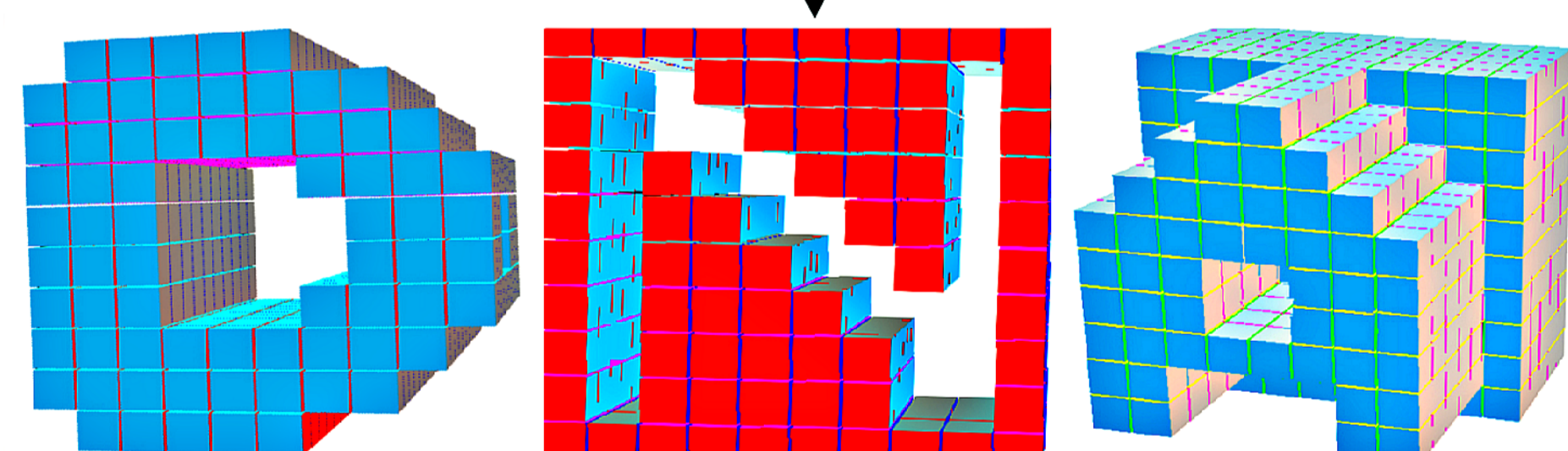
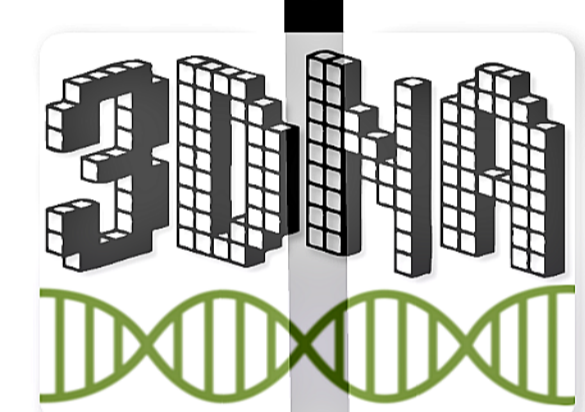
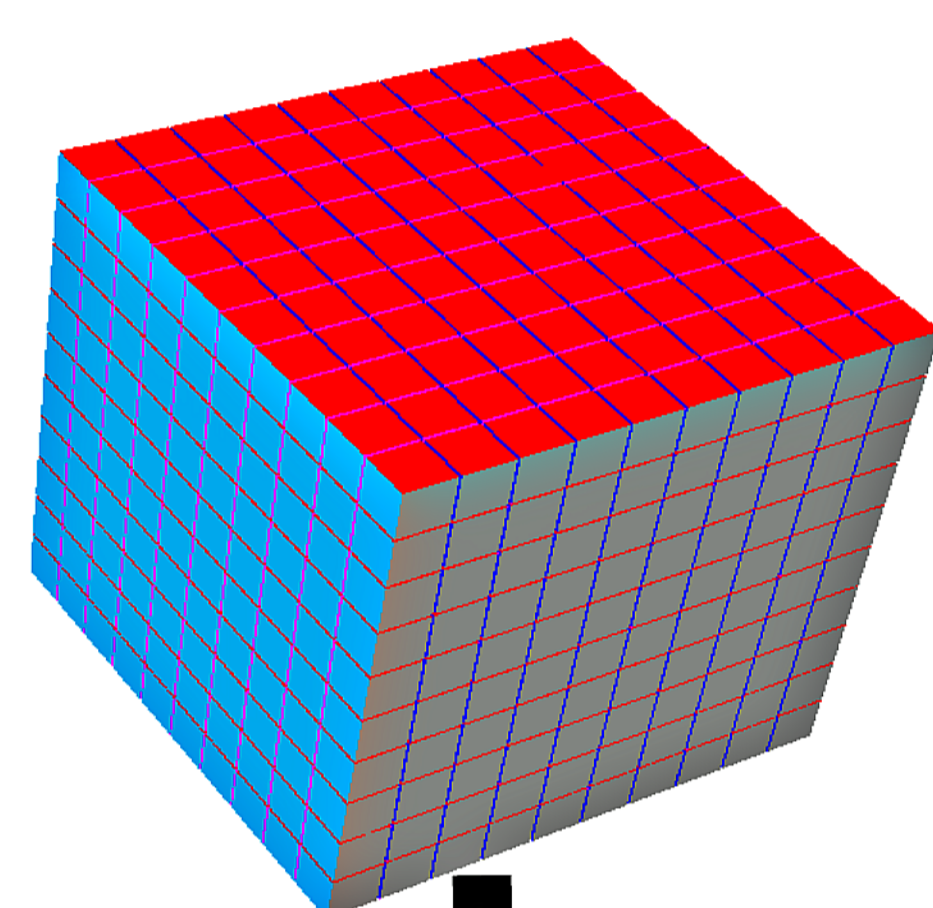
3DNA: A Tool for DNA Sculpting

Shikhar Kumar Gupta, Foram Joshi, Dixita Limbachiya and Manish K. Gupta

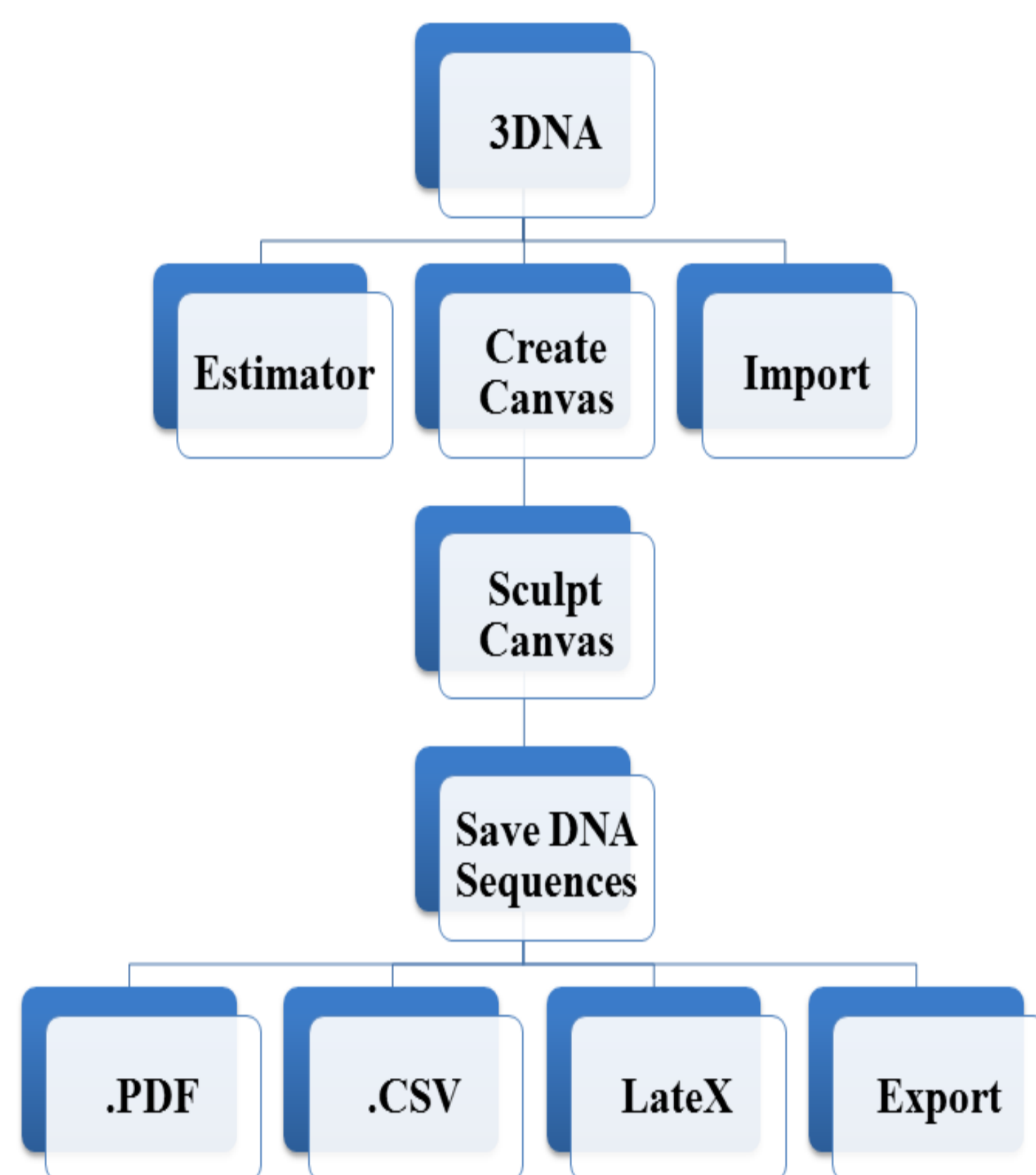
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Abstract

Sculpting has a long history and is often considered as one of the oldest art forms. In this era of DNA Nanotechnology it is now possible to create nano-sized sculptures out of blocks of DNA. 3DNA is a software suite using which you can design, edit and visualize complex 3D structures.



Main Modules



Software Output

3DNA generates three types of output files as illustrated below. Also, files are imported and exported in .3dna format.

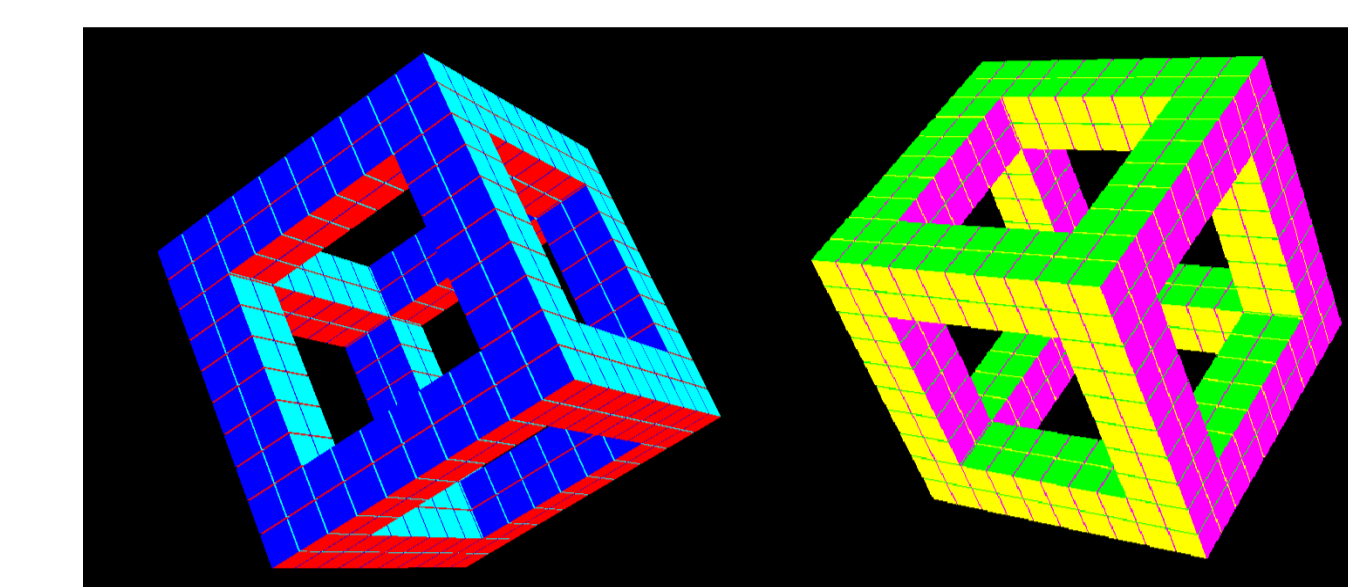
Detailed DNA Data

DNA Sequences	Voxels
ATACGTTATTTTTT	[000]
CGGCGAAATTTTTTTTTTTTTTTGGCCGGTA	[100,110]
ACTCTGTTTTTTTT	[200]
AGGCCACCTTTTTTTTTTTTTTAAACAC	[010,020]
TTCACCAGTTTTTTTTTTTTTCAACCGGA	[210,220]
GCAGTACTTTTTTTTTTTTACCAAGA	[120,130]
ATGGTAGCAGATTACTCTGAGAGGATTGACC	[320,330]
ACCACTGGTGGGTTT	[420]
GGTAGCGTTCGGCGTTTTCCATAATTGAATGT	[520,530]
TCCGATAGTTTTTTTTTTTTTAAACCGGC	[030,040]
CTGGGAGGTTTTTTTTTTTTTTGAAAGGCT	[230,240]
CTAGGAAAAGTCGACAACTCGAAAAGCTCA	[430,440]
AGCATAGGTTTTTTTTTTTTTTGTATGTT	[140,150]
GTTAGAGCTCTACTAGTGGACCTTGTTGAGT	[340,350]
GAGGTATGCCGGTGGTTATTCCGAATGTC	[540,550]
TTTTTTTTACAATTG	[050]
TTTTTTTTGTGGTGT	[250]

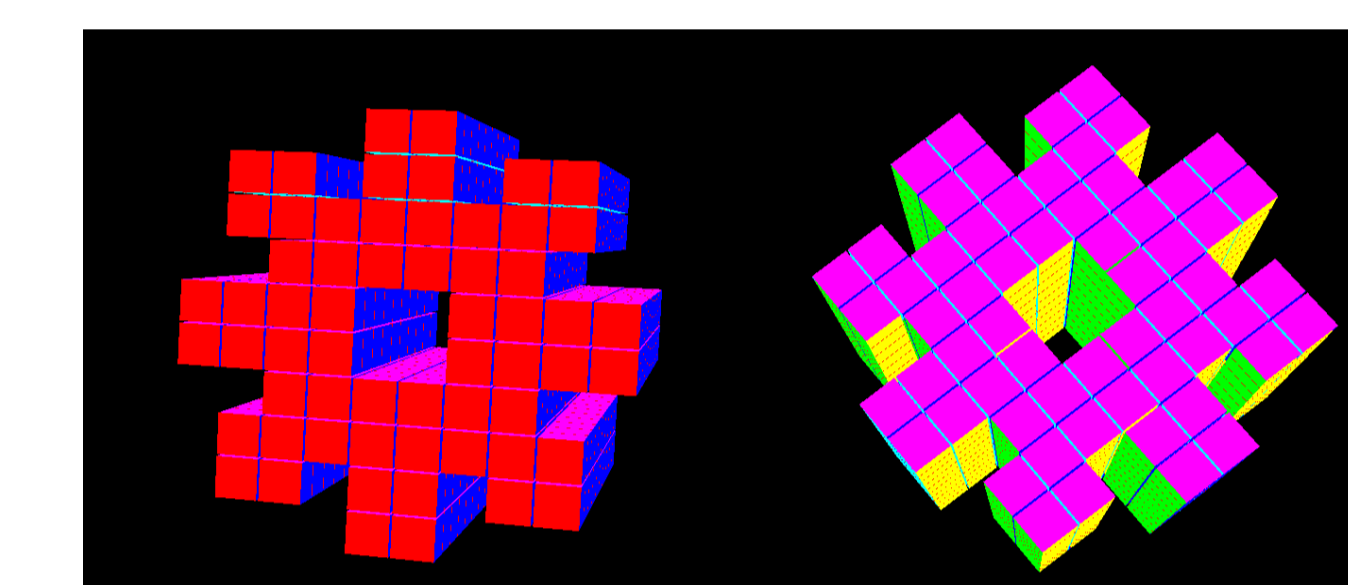
3DNA PDF File

DNA Sequences	Voxels
ATACGTTATTTTTT	[000]
CGGCGAAATTTTTTTTTTTTTTTGGCCGGTA	[100,110]
ACTCTGTTTTTTTT	[200]
AGGCCACCTTTTTTTTTTTTTTAAACAC	[010,020]
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AGCATAGGTTTTTTTTTTTTTTGTATGTT	[140,150]
GTTAGAGCTCTACTAGTGGACCTTGTTGAGT	[340,350]
GAGGTATGCCGGTGGTTATTCCGAATGTC	[540,550]
TTTTTTTTACAATTG	[050]
TTTTTTTTGTGGTGT	[250]

Sample 3DNA images



3D hollow cube created using 3DNA



3D gear created using 3DNA

Advantages

- Simple and user-friendly
- Flexibility through export and import functionality
- Scalability of structure
- Visualization of canvas in a 360° view

Future Aspects

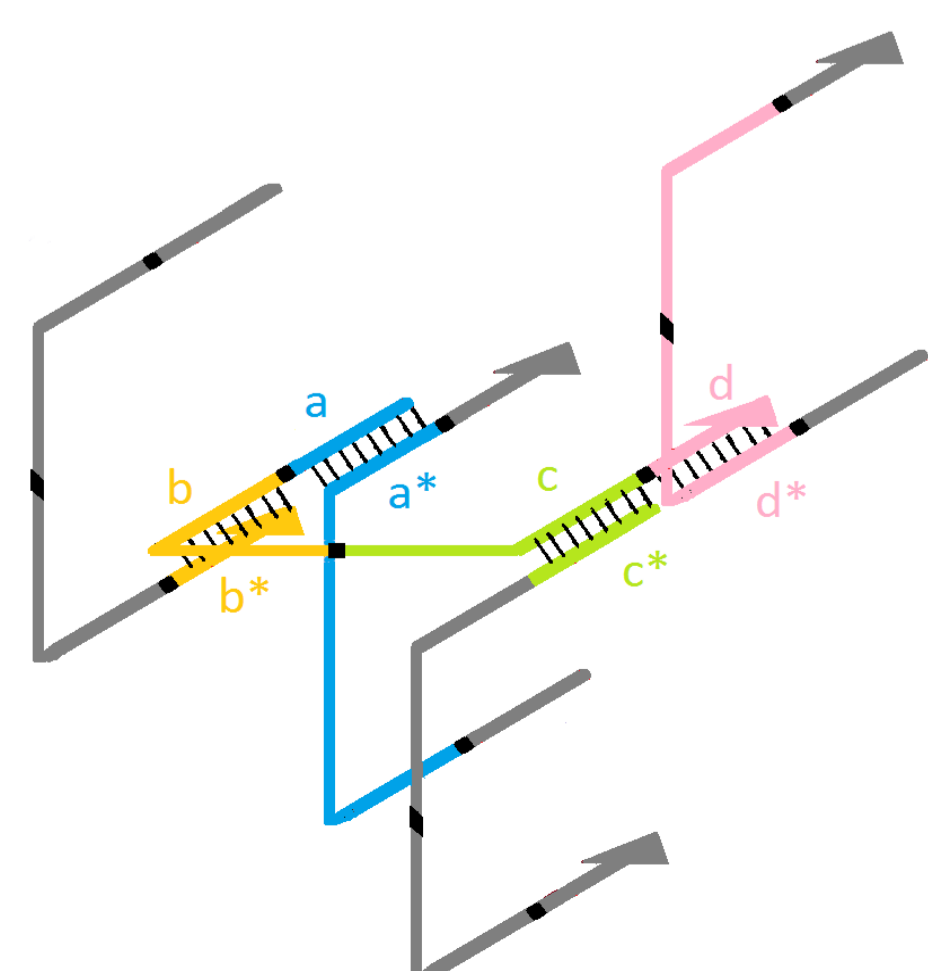
- 3D image rendering and 3D printing of DNA
- DNA Brick visualization
- Molecular canvas for curved surfaces
- Implementation of mathematical functions on the Molecular canvas

References

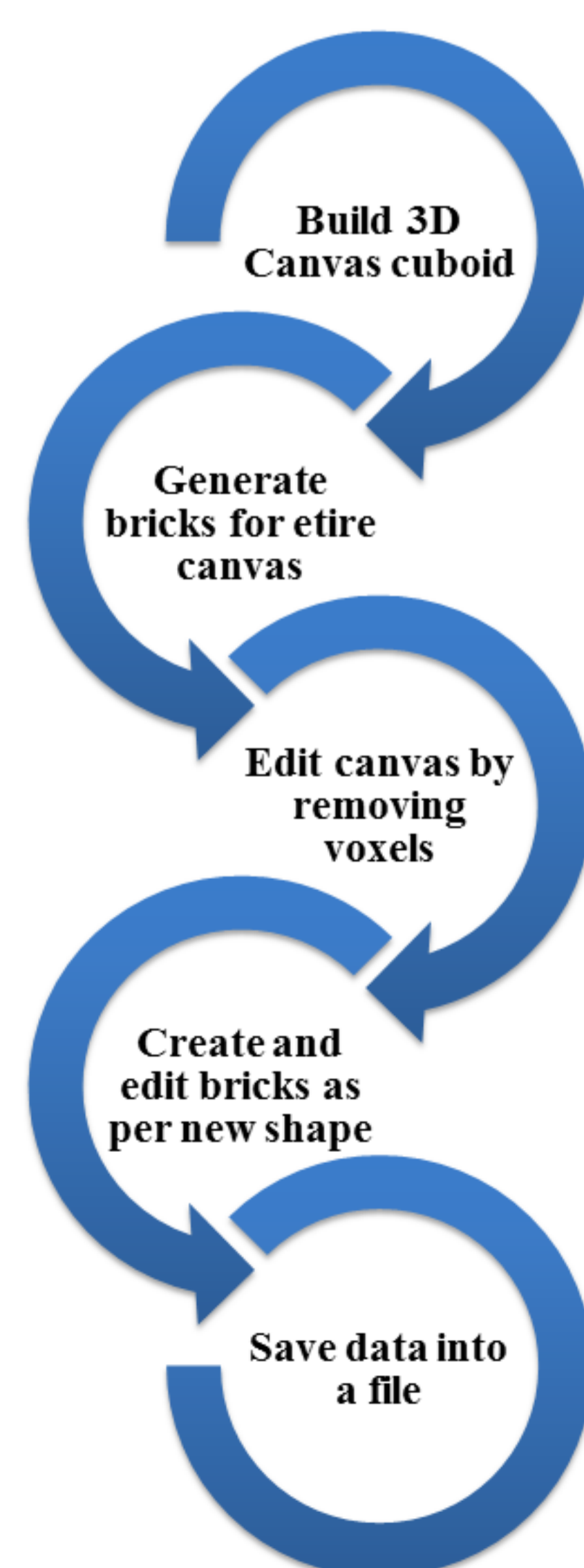
1. Yonggang Ke, Luvena L. Ong, William M. Shih, Peng Yin *Three-Dimensional Structures Self-Assembled from DNA Bricks* Science 30, November 2012

Self Assembling DNA Bricks

DNA brick self-assembly is the process by which DNA strands function as lego bricks and adopt a defined arrangement without guidance or management from an outside source. 3DNA works on the process of self-assembly of its individual molecular pixels forming a molecular canvas. Each molecular pixel is denoted by a Single Stranded DNA.



Workflow



Estimator Function

It calculates the cost of experiment(USD) based on the total number of nucleotides.

