

DNA Computing: What Will the Programming Language Be?

By Peter Marino

DNA Programming

The idea of using the Watson-Crick building blocks to assemble a functional program is not new. It is, after all, the way organic life forms function. The distinction between the inorganic computers we use today and the organic computers of the future is simply the medium used to calculate or compare two values.

Peeled down its bare essence, all digital computers do is one of two things: Either add two values together or compare two values and determine if they are the same.

Inorganic computers are by definition rigid structures. Various metals and semiconductor materials are bonded to a non-conductive silica substrate to form the component parts of the arithmetic, logic and memory along with the necessary supporting circuitry. Organic computers appear to be self-supporting structures, in that the framework is integrated with the computational units, analogous to comparing a static office building to a kinetic sculpture.

Initially, any nucleotide computer will need to be "manually assembled," with the first functional parts becoming the tools to build ever more sophisticated organic devices. The mechanics of attaching Watson-Crick pairings into various forms to replicate the processes of AND gates, OR gates and NOT inverters for logic circuits and calculation engines are still speculative. Each model, however, has methodology for sculpting strands by coupling and decoupling assemblers. A compiler will be required to check the DNA coding to ensure problematic combinations of the Watson-Crick pairs have not been created inadvertently. Because of the nature of the limited number of pairings, it seems unlikely that any

interpreted version of DNA coding is probable. However, it's only a matter of time before true artificial intelligence is capable of passing the Turing test.



The interface between the coder and the DNA engine is all speculative at this point. Researchers have been focusing their attention on the methodologies of connectivity between the component parts of nucleotides to establish a solid foundation for supporting DNA sculptures.

Much as the initial research for LASER technology was focused on creating a beam of coherent light, the context of the frame was built before any attempts were made to modulate the beam to carry digital traffic. The same is true of the current state of the art in DNA programming.

A more apropos analogy can be made regarding the development of computer languages. The microcode or basic instruction set had to be established and implemented before object code could be assembled to form a program capable of performing a task. As the nature of computer languages, higher level languages were developed to enable coders to perform tasks of ever-increasing complexity. DNA and nucleic programming will follow a similar development cycle.

The future of DNA coding is bright. We already know the concept works, because organic life is a massive series of DNA programs running concurrently and independently of each other at the nanoscopic level, yet capable of complex interactions at macroscopic levels. The proof of concept has already been amply demonstrated by the hundreds of thousands of living species. The question isn't "Can DNA be used as a computer language?" It is rather "How can we write DNA code that is capable of achieving productive results?"

Today's DNA researchers are already at work, with several proposals for handling the mechanical aspects of assembling nucleotides. It is only a matter of time and concentrated effort that stands between us and addressing DNA programs. Stay tuned for quantum leaps to be made in the realm of DNA programming and DNA computers as it will probably be the most natural module for integrating technology into humans.

Read more:

[A programming language for composable DNA circuits, by Andrew Phillips](#)

[Storing Clocked Programs Inside DNA: A Simplifying Framework for Nanocomputing, by Denniss Shasha](#)



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