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Researchers build DNA neural network that thinks
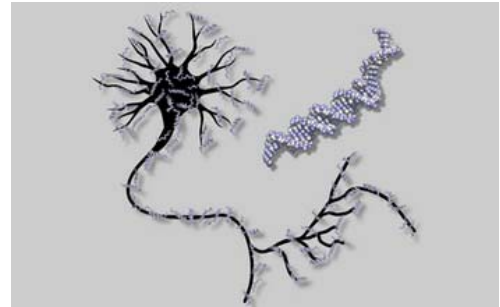
by Tim Hornyak

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Researchers at the California Institute of Technology say they have built what they call the world's first artificial neural network out of DNA molecules and that it can answer questions correctly.

Postdoctoral scholar Lulu Qian and colleagues describe "how molecular systems can exhibit autonomous brain-like behaviors" in a **paper** published about their research in the July 21 issue of the journal Nature.

Taking their cue from the limited intelligence exhibited by single-celled organisms, the researchers built four neurons made up of 112 distinct DNA strands (by contrast, the human brain has some 100 billion neurons).

This rudimentary neural network works on a simple input-output mechanism called a strand-displacement cascade. Essentially, synthesized strands of DNA float around in water and join to other strands that have complementary base pair structures, creating an input. When such a union occurs, a strand of DNA will be shed, creating an output.

The technique was previously used to build the largest-ever DNA circuit, one that can compute **square roots**, according to Caltech.

The neural net was built of four artificial neurons and 112 DNA strands.

(Credit: Caltech)

In the latest research, the team trained the neural network to play a memory game in which it would correctly "identify" four scientists based on specific yes or no questions--for instance whether the scientist was British.

Players dropped DNA strands representing an incomplete set of answers into a test tube. The network then provides the answer--the identity of the correct scientist--by fluorescent signals.

When presented with 27 different ways of answering the questions, the DNA "brain" responded correctly each time.

Caltech said this proof-of-concept technique for pattern recognition shows that the DNA network has the basic ability to think, but it is very slow, taking eight hours to identify the scientists in the game, and the DNA strands can only be used once.

Still, DNA neural nets could have powerful applications in the future, such as working within cells to diagnose diseases.

"Our results suggest that DNA strand displacement cascades could be used to endow autonomous chemical systems with the capability of recognizing patterns of molecular events, making decisions and responding to the environment," Qian and colleagues wrote in Nature.

See a detailed video explanation of the research **here**.

*(Via **Laboratory Journal**)*

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