

Evolution is at work in computers as well as life sciences

October 16 2018, by Arend Hintze



Credit: AI-generated image ([disclaimer](#))

Artificial intelligence research has a lot to learn from nature. [My work](#) links biology with computation every day, but recently the rest of the world was reminded of the connection: The [2018 Nobel Prize in Chemistry](#) went to Frances Arnold together with George Smith and Gregory Winter for developing major breakthroughs that are collectively

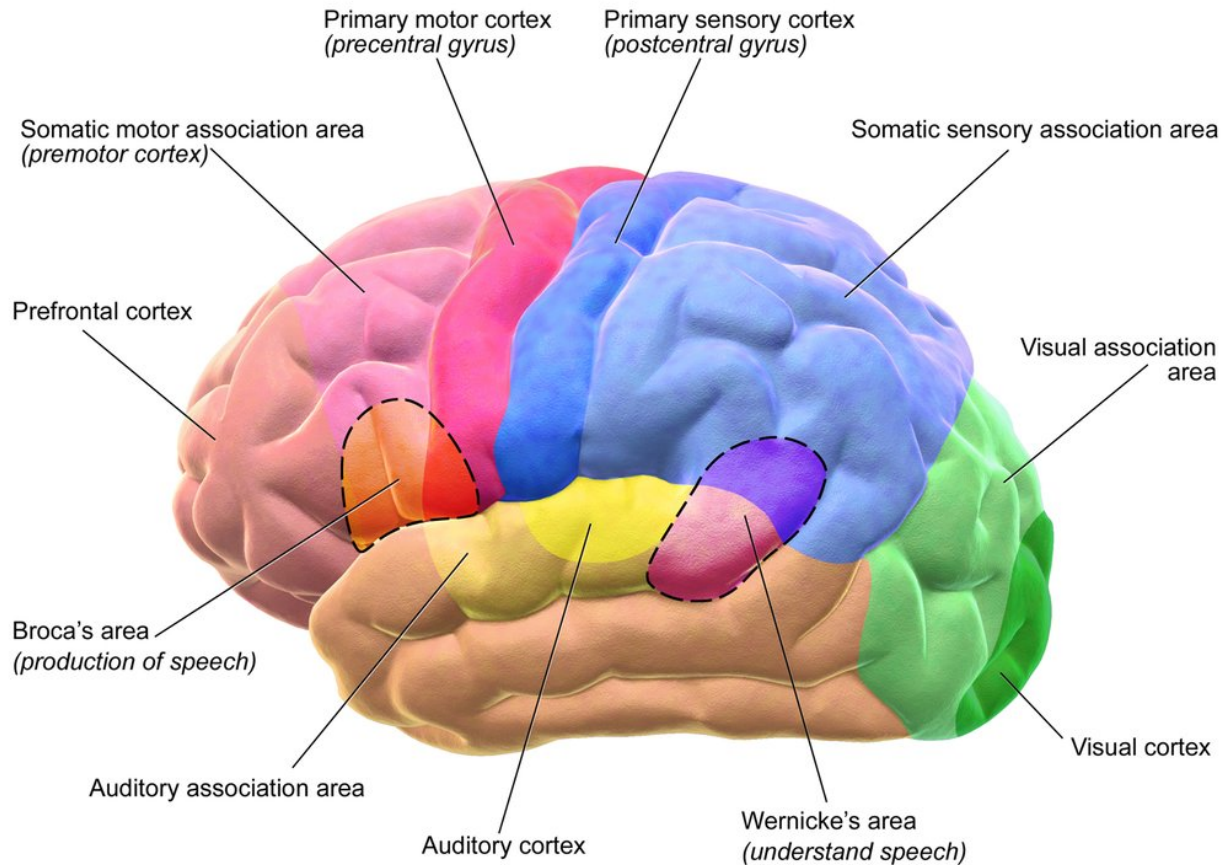
called "[directed evolution](#)." One of its uses is to improve protein functions, making them better catalysts in biofuel production. Another use is entirely outside chemistry – outside even the traditional life sciences.

That might sound surprising, but many research findings have very broad implications. It's part of why just about every scientist wonders and hopes not only that maybe they would be selected for a Nobel Prize, but, far more likely, that the winner might be someone they know or have worked with. In the [collaborative academic world](#), this [isn't terribly uncommon](#): In 2002, I was studying under a scholar who had studied under one of the three co-winners of that year's [Nobel Prize in Physiology or Medicine](#). This year, it happened again – one of the winners has written a couple of papers with a [scholar I have collaborated with](#).

Beyond satisfying my own vanity, the award reminds me how useful [biological concepts](#) are for engineering problems. The best-known example is probably the invention of Velcro hook-and-loop fasteners, [inspired by burrs that stuck to a man's pants](#) while he was walking outdoors. In the Nobel laureates' work, the natural principle at work is [evolution](#) – which is also the approach I use to develop artificial intelligence. My research is based on the idea that evolution led to general intelligence in biological life forms, so [that same process](#) could also be used to develop computerized intelligent systems.

When designing AI systems that control virtual cars, for example, you might want safer cars that know how to avoid a wide range of obstacles – other cars, trees, cyclists and guardrails. My approach would be to evaluate the safety performance of several AI systems. The ones that drive most safely are allowed to reproduce – by being copied into a [new generation](#).

Motor and Sensory Regions of the Cerebral Cortex



A map of the cerebral cortex. Credit: [Bruce Blaus/wikimedia](#), [CC BY](#)

Yet just as nature does not make identical copies of parents, [genetic algorithms](#) in computational evolution let mutations and recombinations create variations in the offspring. Selecting and reproducing the safest drivers in each new generation finds and propagates mutations that

improve performance. Over many generations, AI systems get better through the same method nature improves upon itself – and the same way the Nobel laureates made better proteins.

In the effort to understand human intelligence, many researchers are working to reverse-engineer the brain, figuring out how it works at all levels. Complex gene networks control the neurons that form the layers of the neocortex that are sitting on top of a [highway of connections](#). These interconnections support communications between the different [cortical regions](#) that make up most of our cognitive functions. All of this is integrated into the phenomenon of [consciousness](#).

Deep learning and neural networks are computer-based approaches that attempt to recreate how the brain works – but even they can only achieve the equivalent activity of a clump of brain cells [smaller than a sugar cube](#). There remains an enormous amount to learn about the brain – and that's before trying to write the intensely complicated software that can emulate all those biological interactions.

Capitalizing on evolution can make systems that seem lifelike and are inherently as [open-ended and innovative](#) as natural evolution is. It is also the key methodology used in [genetic algorithms](#) and [genetic programming](#). The Nobel Prize committee's recognition highlights a technology that has evolution at its core. That indirectly justifies my own research approach and the idea that [evolution in action](#) is a critical research topic with vast potential.

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