Combining AI and Crispr Will Be Transformational

The genome-editing technology can be supercharged by artificial intelligence—and the results are already being felt.

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In 2025, we will see AI and machine learning begin to amplify the impact of Crispr genome editing in medicine, agriculture, climate change, and the basic research that underpins these fields. It's worth saying upfront that the field of AI is awash with big promises like this. With any major new technological advance there is always a hype cycle, and we are in one now. In many cases, the benefits of AI lie some years in the future, but in genomics and life science research we are seeing real impacts right now.

In my field, Crispr gene editing and genomics more broadly, we often deal with enormous datasets—or, in many cases, we *can't* deal with them properly because we simply don't have the tools or the time. Supercomputers can take weeks to months to analyze subsets of data for a given question, so we have to be highly selective about which questions we choose to ask. AI and machine learning are already removing these limitations, and we are using AI tools to quickly search and make discoveries in our large genomic datasets.

In my lab, we recently used AI tools to help us find small gene-editing proteins that had been sitting undiscovered in public genome databases because we simply didn't have the ability to crunch all of the data that we've collected. A group at the Innovative Genomics Institute, the research institute that I founded 10 years ago at UC Berkeley, recently joined forces with members of the Department of Electrical Engineering and Computer Sciences (EECS) and Center for Computational Biology, and developed a way to use a large language model, akin to what many of the popular chatbots use, to predict new functional RNA molecules that have greater heat tolerance compared to natural sequences. Imagine what else is waiting to be discovered in the massive genome and structural databases scientists have collectively built over the recent decades.

These types of discoveries have real-world applications. For the two examples above, smaller genome editors can help with more efficient delivery of therapies into cells, and predicting heat-stable RNA molecules will help improve biomanufacturing processes that generate medicines and other valuable products. In health and drug development, we have recently seen the approval of the first Crispr-based therapy for sickle cell disease, and there are around 7,000 other genetic diseases that are waiting for a similar therapy. AI can help accelerate the process of development by predicting the best editing targets, maximizing Crispr's precision and efficiency, and reducing off-target effects. In agriculture, AI-informed Crispr advancements promise to create more resilient, productive, and nutritious crops, ensuring greater food security and reducing the time to market by helping researchers focus on the most fruitful approaches. In climate, AI and Crispr could open up new solutions for improving natural carbon capture and environmental sustainability.

It's still early days, but the potential to appropriately harness the joint power of AI and Crispr, arguably the two most profound technologies of our time, is clear and exciting—and it’s already started.