

NEWS TITTLE



Why did humans evolve the eyes we have today?

While scientists can’t go back in time to study the environmental pressures that shaped the evolution of the diverse vision systems that exist in nature, a new computational framework developed by MIT researchers allows them to explore this evolution in artificial intelligence agents.

The framework they developed, in which embodied AI agents evolve eyes and learn to see over many generations, is like a “scientific sandbox” that allows researchers to recreate different evolutionary trees. The user does this by changing the structure of the world and the tasks AI agents complete, such as finding food or telling objects apart.

This allows them to study why one animal may have evolved simple, light-sensitive patches as eyes, while another has complex, camera-type eyes.

“While we can never go back and figure out every detail of how evolution took place, in this work we’ve created an environment where we can, in a sense, recreate evolution and probe the environment in all these different ways. This method of doing science opens to the door to a lot of possibilities,” says Kushagra Tiwary, a graduate student at the MIT Media Lab and co-lead author of a paper on this research.

He is joined on the paper by co-lead author and fellow graduate student Aaron Young; graduate student Tzofi Klinghoffer; former postdoc Akshat Dave, who is now an assistant professor at Stony Brook University; Tomaso Poggio, the Eugene McDermott Professor in the Department of Brain and Cognitive Sciences, an investigator in the McGovern Institute, and co-director of the Center for Brains, Minds, and Machines; co-senior authors Brian Cheung, a postdoc in the Center for Brains, Minds, and Machines and an incoming assistant professor at the University of California San Francisco; and Ramesh Raskar, associate professor of media arts and sciences and leader of the Camera Culture Group at MIT; as well as others at Rice University and Lund University. The research appears today in Science Advances.

Building a scientific sandbox

The paper began as a conversation among the researchers about discovering new vision systems that could be useful in different fields, like robotics. To test their “what-if” questions, the researchers decided to use AI to explore the many evolutionary possibilities.

“What-if questions inspired me when I was growing up to study science. With AI, we have a unique opportunity to create these embodied agents that allow us to ask the kinds of questions that would usually be impossible to answer,” Tiwary says.


To build this evolutionary sandbox, the researchers took all the elements of a camera, like the sensors, lenses, apertures, and processors, and converted them into parameters that an embodied AI agent could learn.

They used those building blocks as the starting point for an algorithmic learning mechanism an agent would use as it evolved eyes over time.

“We couldn’t simulate the entire universe atom-by-atom. It was challenging to determine which ingredients we needed, which ingredients we didn’t need, and how to allocate resources over those different elements,” Cheung says.

In their framework, this evolutionary algorithm can choose which elements to evolve based on the constraints of the environment and the task of the agent.

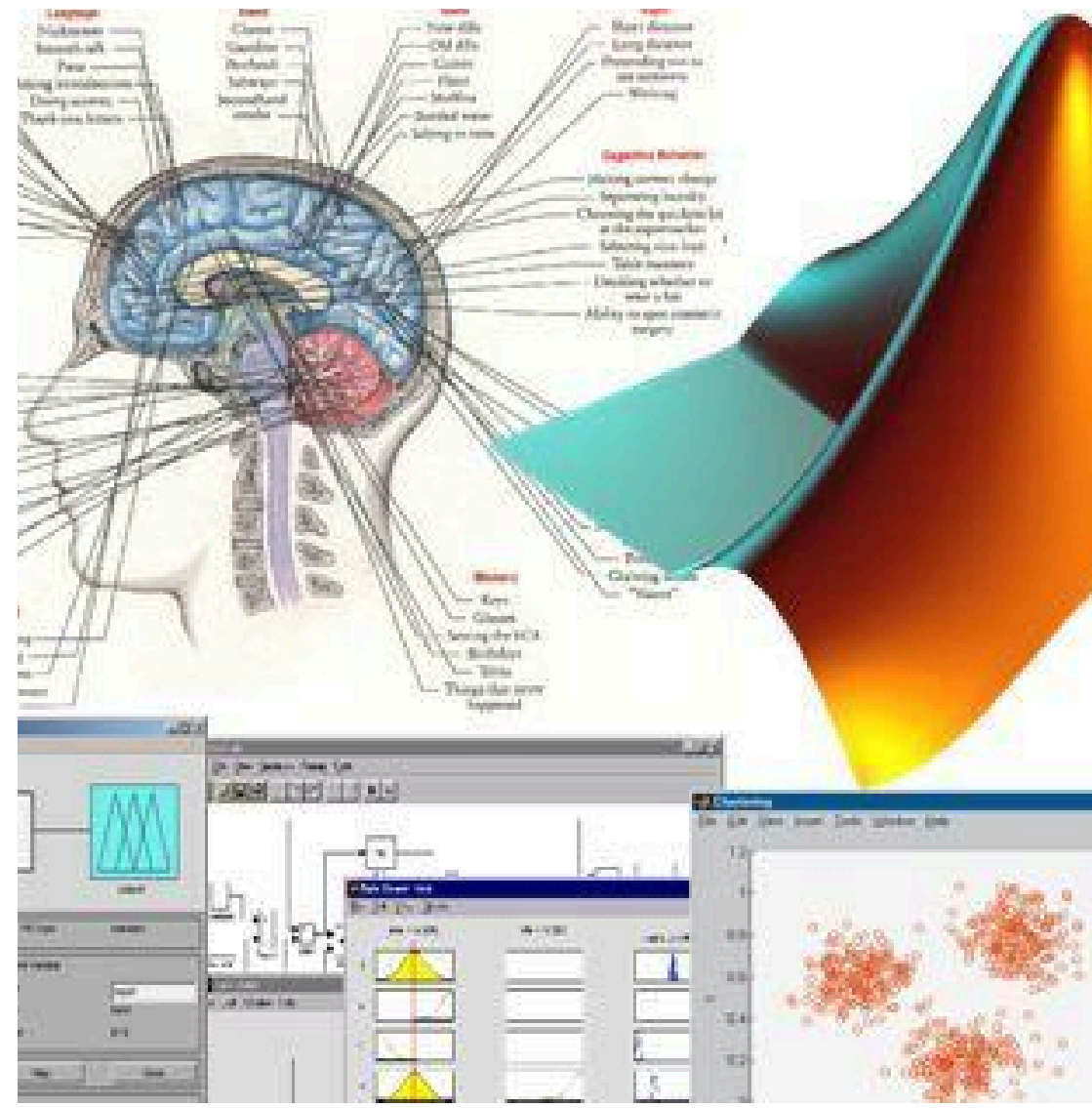
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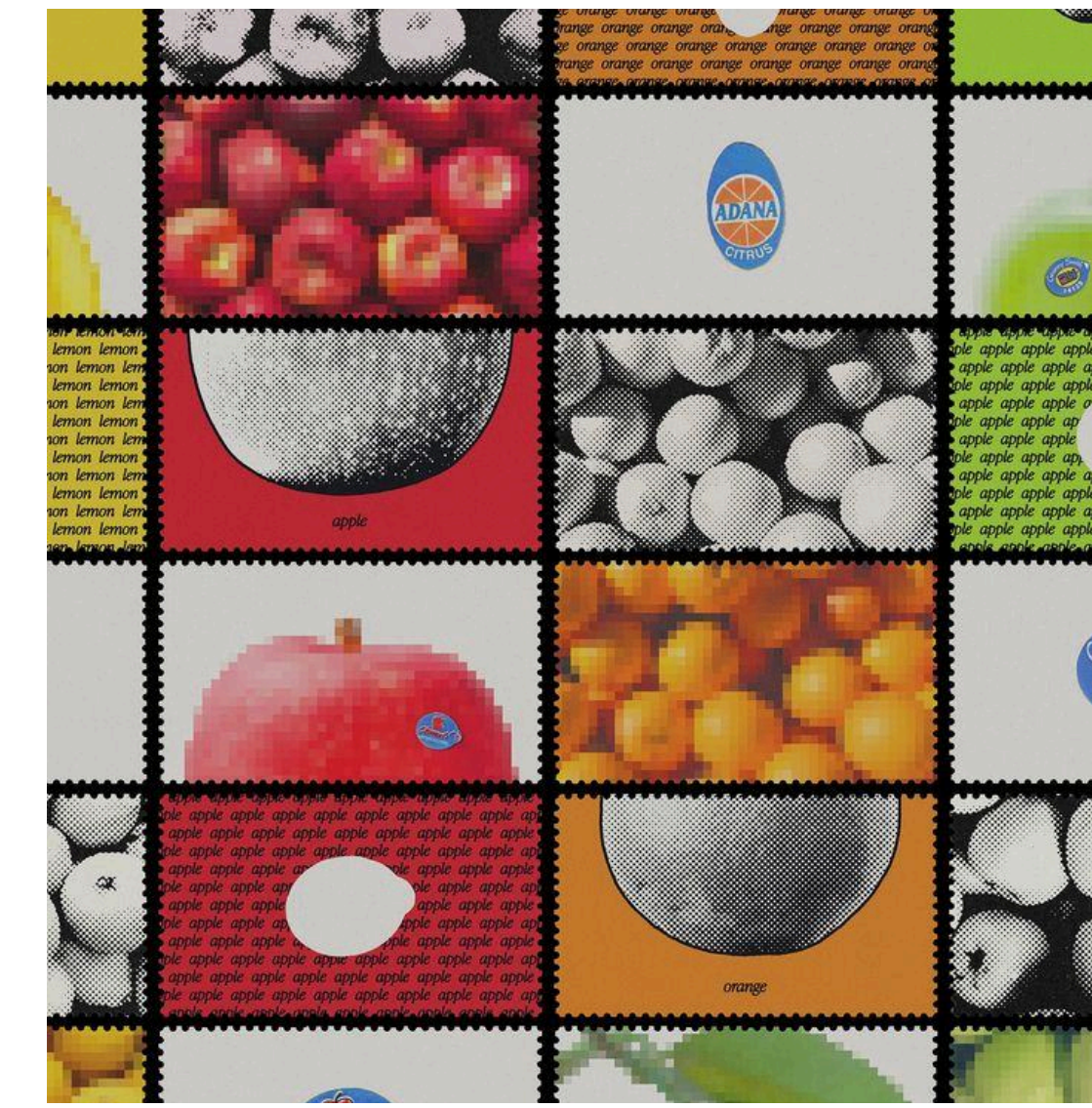
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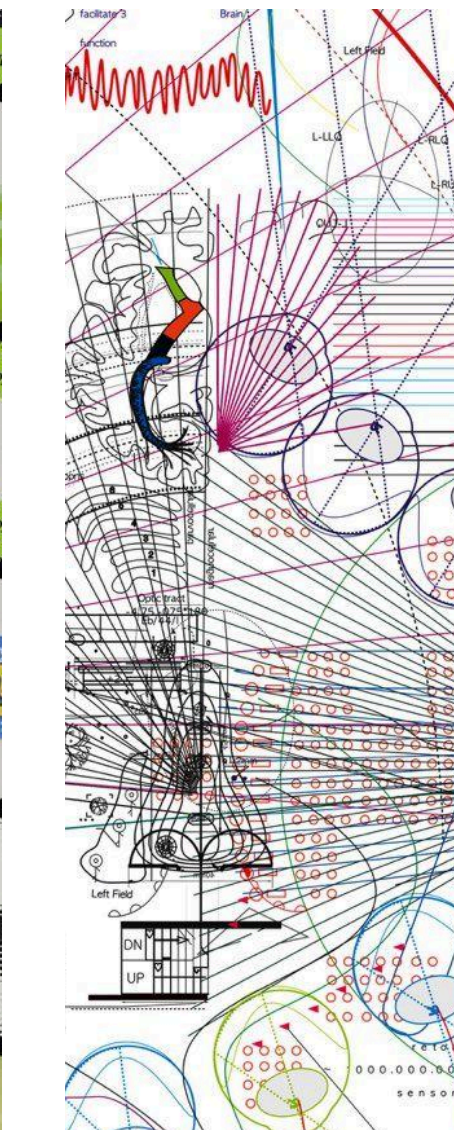
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