Are we living in a Matrix-style simulation?

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The so-called “simulation argument” was popularized in a 2003 paper by University of Oxford professor Nick Bostrom and has since become a high-profile topic of discussion in classrooms and conferences across the country. Credit: YoungHee Jang

A number of philosophers, futurists, and technologists have come to believe that we are living in a computer-simulated world, kind of like a

real-life version of The Matrix. The so-called "simulation argument" was popularized in a 2003 paper by University of Oxford professor Nick Bostrom and has since become a high-profile topic of discussion in classrooms and conferences across the country.

For Elon Musk and Neil deGrasse Tyson, there's a good chance that our entire existence is a program on someone else's hard drive, that we're the playthings of our technologically advanced future descendants. "I think the likelihood may be very high," Tyson said. "We would be drooling, blithering idiots in their presence." As Musk put it, "There's a billion to one chance we're living in base reality."

Dmitri Krioukov, associate professor in the Department of Physics, directs the Network Science Institute's DK-Lab, which focuses on network theory. We asked him to explain the logic behind the simulation argument and whether we might be living in a Matrix–style world.

Musk cites the speed with which video games are improving as his primary reason for believing that we're living in a simulated world. "Given that we're clearly on a trajectory to have games that are indistinguishable from reality," he said, "it would seem to follow that the odds that we're in base reality is one in billions." Simply put, do you think we are living in a simulation?

No, I don't think so, and here is why. The simulation hypothesis assumes that some future posthuman civilization that is super powerful is simulating worlds of their ancestors—including us. Since they are super powerful, they simulate a humongous number of such worlds, so that the probability that we are simulated is much higher than that we are real.

But according to the same logic, the simulations of worlds similar to theirs must comprise a negligible fraction of all their simulations. Most of these simulations are simulations of worlds completely different from theirs, with completely different physics. With high probability, we are in one of such worlds. Therefore, all our discussions and speculations about our simulators, including the simulation hypothesis itself, cannot be correct, since we've made a wrong assumption that their real physics and our simulated physics are similar. With high probability, they are not.

In other words, I think that the simulation hypothesis in its original weak form (similar physics here and there) is self-defeating as logically inconsistent. However, if we acknowledge the more consistent and strong version (different physics here and there), then we cannot say anything at all about our simulators, other than they must be good at what they're doing, as apples always fall, birds sing, politicians speak, while quantum particles entangle.

Some researchers have said that the simulation theory could be tested. What experiment would you design to test whether we're living in a simulated world?

In principle, the strong version of the hypothesis cannot be tested. It is entirely unverifiable, unfalsifiable, irrefutable, and thus unscientific. This impasse illustrates the point that once we take one step along this dead-end path, its solipsistic end is just a few steps away.

A somewhat similar example is the Boltzmann brain paradox, a much likelier scenario than the simulation hypothesis. Imagine all molecules of air in your dining room get together, by pure chance, in one half of the room. The probability of this event is tiny, but not zero. In the next moment, the molecules will be all over the room again, so that there

won't be enough time for you to suffocate. Imagine now the air molecules group together in an intricate structure, again by pure chance, to form a virtual brain simulating exactly your perception of reality around you. The probability of this event is much tinier, but still not zero. This virtual brain is called a Boltzmann brain, and the problem is that since our universe is so much larger, possibly infinitely larger, than your dining room, the probability of the appearance of Boltzmann brains in it is much higher than the probability of the appearance of your real brain. Your real brain requires the sun and Earth and life on Earth to form—all too complicated, compared to a random structure simulating your perception of the world around you.

Boltzmann brains are a paradox because, while they are much more likely to form than real brains, they dissolve the next moment, while you continue to perceive reality consistently. One way out of the paradox is to figure out what cosmological models—which attempt to explain the origin and nature of the universe—suppress the rate of appearance of Boltzmann brains in the universe, so that our real brains would be more likely. This task, a serious problem in modern cosmology, turns out to be rather difficult. A much "simpler" way out is to say that the physics that creates Boltzmann brains is entirely different from virtual physics that these brains perceive, including space and time. Real physics is thus completely inaccessible to our Boltzmann brains, a proposition bordering on solipsism.

Suppose we are living in a simulated world. Does it even matter? What are the implications for us humans?

Aside from some anecdotal implications, it does not matter, of course. If you feel like entertaining yourself with the simulation hypothesis, please feel free to do so, but please keep in mind that in this case it is much

more likely that you cannot have any access to the simulating reality in principle.

Our (simulated) reality is quite perfect so far. Physics and mathematics that we know never break. Therefore, according to Occam's razor, they are real by definition. We can never decide on the opposite in principle, unless the laws of physics start breaking apart one day. Therefore, please proceed with living your normal life even if you believe you are in simulation, unless one day an apple, instead of falling on your head from the tree under which you're sitting, starts levitating and speaking to you. Even in that case, the first thing to do is not to conclude that you are being badly simulated, but to talk to a specialist.

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