# Life, the Universe, and Everything

**Quantum mechanic Seth Lloyd says we really are controlled by a computer.**
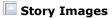
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**Seth Lloyd** is the kind of guy you'd like to have a beer with. Between gulps, the MIT prof will impart the details of how the universe really works. And if you order another, he'll give you a summary of one of the most mind-boggling ideas emerging in science today. His new book, *Programming the Universe*, is a plainspoken tale of how the universe is - tell me if you've heard this before - one very large quantum computer. - *Kevin Kelly*

**WIRED: I hear you're a quantum computer repair guy.**
**LLOYD:** Yes, I am a quantum mechanic! Those darn quantum computers break all the time.

**You've jumped from working on quantum computers to saying, oh, by the way, the universe is a gigantic quantum computer.**
When you zap things with light to build quantum computers, you're hacking existing systems. You're hijacking the computation that's already happening in the universe, just like a hacker takes over someone else's computer.

**What is the universe computing when we are not hijacking it for our own purposes?**
It computes itself. It computes the flow of orange juice as you drink it, or the position of each atom in your cells.

**Um, how many times have you seen *The Matrix*?**
Sadly, only once. In *The Matrix*, what you see is fake - a simulation of bits - which is only a facade of what is real beneath it. But our universe is a simulation so exact that it is indistinguishable from the real thing. Our universe is one big honking quantum �mech�anical computer.

**When did you first start having these visions?**
It's not a new idea, or my idea. The notion that the universe is a computer is as old as Isaac Asimov's story *The Last Question*in the '50s and work by computer scientists Ed Fredkin and Konrad Zuse in the '60s.

**How do you explain *Programming* to your kids?**

I tell them that it says everything in the universe is made of bits. Not chunks of stuff, but chunks of information - ones and zeros.

**Do they believe you?**

My daughter Zoey says, "No, Daddy, everything is made of atoms, except for light." So I tell her, "Yes, Zoey, but those atoms are also information. You can think of atoms as carrying bits of information, or you can think of bits of information as carrying atoms. You can't separate the two."

**I've just put on your magic glasses, and looking around I see that, oh my gosh, everything is computing. Is this just fashionable?**

Computers are our favorite metaphor at the moment, so maybe we see everything as com�puters. But this view is not that facile. Statistical mechanics, which underlies all chemistry, grew out of the realization that the world is information. The mathematical definition of a bit was first �postulated not during the 1930s and '40s when Claude Shannon and Norbert Weiner started information theory but by James Clerk Maxwell and Ludwig Boltzmann during their 19th-�century explorations of the nature of the atom. They were working on thermo�dynamics, but they discovered that the world was made of information.

**Would it be fair to say the universe is a mind?**

You could use that metaphor. And if you did, then you and I and my cat are its thoughts. But the vast majority of the universe's thinking is about humble vibrations and collisions of atoms.

**You seem to be saying that the concept of the universe as one huge quantum computer is not just a metaphor - it's real.**

Absolutely. Atoms and electrons are bits. Atomic collisions are "ops." Machine language is the laws of physics. The universe is a quantum computer.

**Where is this all headed?**

Some folks think life and technology and mind can keep expanding forever. Others say it can't. We are still not clear on that.

**Is there anything we can be clear on?**

If I have one new message to convey in my book, it's that the universe is a system where the very specific details and structures in it are created when quantum bits de-cohere - choose one path out of multiple possibilities - and that this process is identical to quantum computation. That is what I mean by programming the universe.