
From: jeffrey E. <jeevacation@gmail.com>
Sent: Monday, July 6, 2015 10:53 AM
To: [REDACTED]
Subject: Re:

thanks, I met with misha gromov. . =if we are talking about the space of probablites and i underst=nd its only a metaphor. but if the information is widely dispe=sed. are their truly independent probablites.? =A0 and music is also probably constrained by an upper volume, =C2 i never thought of it . some limitation on sound waves interacting.=C2 mu guess is there is an upper limit, certainly ver= loud would drown out very soft. etc. great work thanks<=r>

On Mon, =ul 6, 2015 at 9:59 AM, Seth Lloyd <[REDACTED]> wrote:

<=lockquote class="gmail_quote" style="margin:0 0 0 .8ex;border-left:1px=#ccc solid;padding-left:1ex"> Dear Jeffrey,

=div>My apologies for not responding sooner. I took an email v=cation for a week plus which turned out to be a mistake be=ause I fell irrevocably behind.

That was a very f=n conversation with Noam in Cambridge: he is an amazing thinker (if a tad =nflexible at times).

Your question about entropy =s an important one. The second law of thermodynamics tells us that<=div> systems go to states of high entropy where events are random and =ncorrelated, so that thermal fluctuations appear to be statistic=lly independent. However, if you look under the hood of t=e second law, you find that what is really going on is that the dynamics</=iv> that leads you to this high entropy state is actually generating h=ge amounts of correlations between the different parts of the sy=tem. In fact, the apparently random and independent fluctuations of the parts reflect large correlations with the other=parts of the system. But these correlations are effective=y smeared out over the whole system: to reveal the fact that they are not truly independent, one would have to make measurements on all the=parts together, and tease out the extensive but subtle correlati=ns between them.

For example, even t=ough the apparent high entropy of a gas of molecules reflects all the correlations that are generated by the collisions of molecules over t=me, if one looks at just two molecules in the gas, their motions=will be statistically independent to a high degree of accuracy.<=div>

On your second question, quantum su=erposition is indeed closely analogous to a chord in music: the =trangeness and power of quantum superposition arises out of the =nterference between the different waves in the superposition.<=iv>A classical computer can only register one set of logical values for it= bits at any given time. So a classical computation=is like plain chant: a single sequence of tones without in=erference. By contrast, a quantum computation is li=e a symphony: its power comes from the rich sequence of quantum `chords.	

There is a difference, however. The mor= waves that participate in a quantum superposition, the smaller =he amplitude of each wave: the sum of the square of the am=litudes is always 1. So unlike music, where the volume<=iv>can change, the total `volume' of a quantum chord is always the sam= not matter how many tones are added.

<=r>

Hope these answers help.

<iv>You wrote earlier about life being a process of functors acting on func=ors. Amen!

I am working on trying to prove that sets of ordinary differential equations of the kind that underlie chemical dynamics will spontaneously give rise to such

a functorial dynamics. Not so easy . . .

high Pyrenees, where physics is done primarily on long hikes in the mountains.

Very nice.

Hoping our paths cross soon,

Seth

seth, I've been having many email exchanges with noam. great fun. I am stumped. on the concept of a large probability space? entropy. . ? =C2 if the space is large enough, how does one know if there is independent events. . as the information would take so much time to travel between each and or observer. ? question 2. =A0 in music, one has a dominant tone and then harmonics. . =A0 a chord is a combination of those. lets say 1st third and fifth? =C2 . is that equivalent to a superposition at the quantum level? your ear performs a transform to tease out each tone after the fact. ?

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