When the World Collapses: The Rule of Physics may use min_p as a Regularization

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We live in a world with randomness. Small prob things may happen, but the world is in a good way towards the time axis.

We call those small-prob bad things as "B-things". B-things are those with prob to happen (e.g. 1 in 10,000), and whenever it happens, it makes the world to collapse. It is easy to prove that when time $\to$ inf, those things will absolutely happen. This has been shown in machine learning community. If you train a model without any "make B-things prob to zero" operations, which we can call "regularization" approaches, strange strings may occur everywhere when the model is trying to generate a sequence. This could be the same with our world, where it's provable "B-things" may happen, such as "Due to quantum tunneling and electromagnetic effects, my hand can pass through your hand when I hold it", which is highly imaginable in those scientific novels. But this have never happened yet, either because the universe is too young to have such things happen, or because our world has been "regularized" in some way.

We can imagine we are living in a docker, and the God is trying to setup some "rule-of-physics", the systems of the docker. They create 100 worlds and expect some worlds can have a convergence to infinite age. In such cases, they want the probability that at least one "B-things" happen to be smaller than 1 even when time goes infinite. This is unreleastic when the proabability density of B-things happening is constant, because $1-(1-p)^{\text{inf}}$ is 1. However, when you want this limit result to be smaller than 1, then you probably want to do some reshaping (like the "round down function") towards the probabilities of different events happening.

Let's take top_p and min_p as two examples. When comparing them as potential "physics rules" for our docker-worlds: Top_p allows low-probability B-things to occur as long as they fit within the cumulative threshold. Like we proved in our previous discussion with the [0.9, 0.0001, ...] probability distribution, even with top_p=0.95, some B-things retain non-zero probabilities. Min_p provides stronger protection by completely eliminating events below $min_p * (1-p)$ threshold. As we showed earlier, this creates a finite cutoff time T after which B-things cannot occur at all. This maps interestingly to our universe:

Many theoretically possible quantum events (like tunneling through walls) never manifest at macro scales Systems tend toward stable states rather than

exploring all possibilities Physical constants and fundamental forces seem to act as regularization parameters

Like how language models need regularization to avoid generating chaos over time, perhaps our universe employs similar mechanisms - likely closer to min_p than top_p given the apparent suppression of B-things in practice. This suggests that stable universes capable of developing observers might be those where effective regularization prevents the accumulation of B-things events.

This principle of "hard cutoff" is also reflected in biological evolution. Species become extinct when their fitness (measured by stable population size) falls below 1, effectively eliminating paths that are fundamentally incompatible with the world's progression. Without such mechanisms, poorly adapted species could persist indefinitely through random fluctuations, potentially slowing down the evolutionary advancement of life. This mirrors how min_p regularization creates a clear threshold, below which certain possibilities are completely eliminated rather than allowed to persist with tiny probabilities.

Actually, those Machine Learning core algorithms that are proven effective have been highly overlapped with law of physics, theory of evolution, human brain studies, etc.

This is a very simple example that I found recently about why our rule of physics has shaped our world into its stage for now – ugly but beautiful, random but stable. I actually found some overlap between machine learning algorithms and real-world rules weekly, and surprisingly found that those that could work on machine are actually those that have been working very well in our real life. I have too many thoughts here and wish I have some time to go though them later.

I feel this trend of machine learning will in turn, maybe to the first time of our civilization, guide us towards better humanity systems in a large scale. I just want to say, to this end, machine learning is the greatest thing in the world that you can research for now, as they are just the key towards touching the window of the docker of our universe.