There is no “probability” we are simulated

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Abstract

Simulation theory, the modern incarnation of skeptic philosophy, suggests our reality may be the result of a detailed computer simulation. Various prominent researchers and intellectuals have deduced a probability that our reality is a computer simulation, including Nick Bostrom, David Kipping, Elon Musk, and Neil deGrasse Tyson. Herein we argue that no sensible probability can be quantified.

I. Introduction

Simulation theory suggests consciousness, reality, and our perceptions thereof manifest from detailed computer simulations. Bostrom (2003) proposed simulation theory, at least in its popular form, by considering the implications of an advanced posthuman species gaining significant computing power, vastly outmatching our current limitations, and taking an interest in simulating their ancestors. Bostrom suggests this as a possible explanation for our existence. However, in the broadest sense, there is no reason simulation theory must rely on these human descendants. Any species with sufficient computing power and imagination could produce convincing simulations of reality, and with sufficient imaginative capabilities, there is likewise no reason this foreign species must simulate a reality even vaguely similar to its own. This proposition is especially potent when one imagines a particularly devious nonhuman simulator who simulates a reality intentionally designed to confuse its inhabitants into believing they are simulated by their posthuman descendants. *A priori*, these are simple logical possibilities we cannot eliminate from the full range of possibilities. We caution that it is not clear what exactly “sufficient computing power” entails, and whether this is achievable. For the sake of argument, we accept that sufficient computing power is achievable, even if not within our reality, but within the reality of a hypothetical simulator that could be entirely different from our own, as there exists no reason to believe otherwise.

Simulation theory is the modernized and technologized incarnation of skeptic philosophy. A famous ancient example of skeptic musing can be traced to the Chinese philosopher Zhuangzi, who vividly dreamed one night he was a butterfly. The dream carried such a realness and impact on Zhuangzi that, upon waking, he was forced to question whether he was a man awoken from a dream of being a butterfly, or if he was a butterfly currently dreaming in the form of a man (Watson 2003). Skeptic philosophy has seen many variants since the Butterfly Dream, including the Five-Minute Hypothesis (Russell 1921) and the Brain-in-a-Vat Hypothesis (Putnam 1981), but has largely maintained the tradition of an epistemological questioning of reality and perception.

Simulation theory has largely involved the notion of posthuman simulations as put forth by Bostrom. Video games, virtual reality, and brain-computer interface technologies have progressively increased in their ability to convincingly simulate reality and have subsequently provided a popular lens through which to view simulation theory and skeptic philosophy. However, alongside simulation theory have arisen claims that one can quantify a subjective probability that we exist in a simulation. This again originates with Bostrom (2003), who claims one of the following propositions must be true:

(1) The fraction of civilizations that reach a posthuman stage is close to zero.
(2) The fraction of civilizations interested in running ancestor simulations is close to zero.

(3) The fraction of all people with our kinds of experiences living in a computer simulation is close to one.

Bostrom (2003) then argues Propositions (1-2) suggest the probability we are simulated is close to zero, whereas Proposition (3) suggests the probability we are simulated is close to one. Bostrom (2003) then assumes, in our current state of ignorance as to the truth value of Propositions (1-3), we ought to assign a flat prior probability distribution upon Propositions (1-3). Bostrom (2003) therefore reaches the conclusion that the probability we are living in a computer simulation is one in three. Kipping (2020) uses a Bayesian probability framework to conclude the probability we are simulated is 50% unless we humans begin producing computer simulations, in which case the odds we are simulated rise dramatically. Respectively in a public talk and during a podcast, Elon Musk and Neil deGrasse Tyson argued our state of rapid technological advancement suggests reality and virtual reality will one day become indistinguishable, such that the odds we are *not* simulated are one in billions (McCormick 2016; Ananthaswamy 2020). Tyson then argued, however, that such computing power does not currently exist, and concluded there is only a 50% chance we are simulated (Ananthaswamy 2020).

The respective arguments of Bostrom, Kipping, Musk, and Tyson (BKMT) all rely on the proposition that our hypothetical simulator is largely similar to us, although with far superior technological capabilities. Moreover, these arguments all suggest our current state, namely whether or not we are simulated, is somehow entangled with the mere possibility our descendants will be capable and interested in producing simulations. Herein we challenge this notion and other propositions put forth by BKMT and argue there is no rigorous basis upon which to quantify a probability that we are simulated.

II. There is no rigorous probability we are simulated

We begin by defining probability as the scalar quantification of the amount one believes a given proposition, with zero bounding the minimum amount of belief and one bounding the maximum amount of belief. Probability is not absolute, but rather depends on the available information. As such, if there is no available information, probability cannot be defined. What exactly is meant by *available information*? We assert, if probability is to have even a minimal basis in logic, that available information must minimally be *credible* and *relevant*, which we proceed to define.

By *credible*, we require the information to be true within the assumed logical framework. This does not require the information is provable or true in any absolute sense. Rather, this requires the information is provable within, or otherwise consistent with, the underlying logical framework. Thus, the information may be an assumption or a logical implication of assumptions. Moreover, we require some logical framework to be assumed so that logical reasoning can be used to reach mathematical conclusions, such as the quantification of probability. This requirement is especially important in our context of skeptic philosophy wherein otherwise simple propositions might receive challenge.

By *relevant*, we require that within the assumed logical framework, the information can be logically traced to the subjects relevant to the proposition under consideration. This would involve conditional statements tracing completely from the assumptions of the underlying logical framework to the subjects of the proposition. We will refer to this hereafter as a "logical path." We require this because, otherwise, there would be no evidence capable of distinguishing between hypotheses and consequently increasing or decreasing the amount one believes in the proposition. Moreover, if there were not some logical path between the information and the proposition, then the information and the proposition could have no logical effect on one another, and therefore the information could carry no constraining power with it.

Simulation theory as popularized by Bostrom (2003) involves human civilizations advancing considerably in their computation power and running detailed computer simulations of us, their ancestors. This is an extremely strong restriction on the range of possibilities of the simulation we could be part of. How could we know that our simulator fits these criteria? Suppose our species advanced by many orders of magnitude in computing power and took interest in running detailed computer simulations. Would we be required to simulate only our human ancestors? Could we not simulate another species? Could we not imaginatively simulate an alien species in a world whose physical laws differ entirely from our own? Could we not run a simulation intended to deceive its inhabitants into believing something about us, the simulator, that is explicitly false relative to our own reality? Could we not deceive the inhabitants into believing there is no simulator? Could we not prevent, through explicit lines of code, the inhabitants from obtaining credible and relevant information regarding the proposition they are simulated?

Such questions are natural within the skeptic tradition from which simulation theory was born. Without *a priori* answers to these questions, we have no *a priori* available information in general that can restrict the range of possible simulation theory scenarios, and therefore we have no available information upon which to quantify a probability that we are simulated. Nevertheless, we should still consider the possibility that one might assume some logical framework wherein such information exists to restrict the range of possible simulation theory scenarios.

Suppose we assumed some logical framework wherein information existed, whether in the form of explicit assumptions or implications thereof, with the capability of constraining the range of possible simulation theory scenarios. By the minimal criteria enumerated previously, this information would necessarily be credible and relevant to the subject of our proposition; namely, the simulator we seek to characterize. However, if we have credible information about the simulator, then we necessarily can trace a logical path from our assumed logical framework to the simulator. This would only be possible if the simulator exists (unless, of course, the logical framework merely assumes we are not simulated). Moreover, it would follow trivially from our supposition that the simulator exists. Therefore, if we believe in this supposed logical framework, then we necessarily believe we are simulated, in which case there is no need to quantify a probability.

Why, then, do BKMT all arrive at nontrivial probabilities? Two reasons emerge. First, BKMT work within logical frameworks that make strong assumptions about the nature of our hypothetical simulator. Namely, BKMT assume the simulator is largely similar to us but technologically advanced. This requires knowledge of the characteristics of the simulator, and this could only be true if BKMT assume there exists a logical path to the simulator such that a constraint may be placed on the possible range of simulator characteristics. Thus, BKMT implicitly assume the simulator exists in their arguments before even quantifying their probabilities.

We additionally note that BKMT's probability quantifications would be problematic even if the aforementioned characteristics of the simulator had not been assumed. BKMT assume prior probability distributions either implicitly or explicitly. Assuming a prior probability distribution is not only common practice but necessary in probability analysis, for probability is quantified by considering the effect of introducing new information to an existing probability computation. A flat prior probability distribution is frequently assigned and assumes we should treat each logically possible proposition as equally likely to be true. Although there are different prior probability distributions, each generally assumes we can numerically compare the probability of multiple distinct propositions. In most situations where the subjects of the propositions can be safely assumed to exist, this starting point is valid. However, our proposition concerns the existence of a subject itself, and BKMT have not argued such propositions can be numerically compared in the absence of available information. To deduce whether this prior numerical comparison of propositions

is even possible, one would at least need access to credible and relevant information concerning the subjects of the propositions. Again, this requires the existence of a logical path to the subjects of the propositions. As such, even assigning a prior probability distribution necessarily assumes whether the simulator exists, and therefore answers the question before a probability can be quantified.

We note that simulation theory presents a rather unique case where subjective probability cannot be quantified. For instance, our argument does not suggest a probability cannot be quantified regarding the proposition that extraterrestrial life exists. Even in the absence of explicit evidence for or against this proposition, we could point to astronomical observations of exoplanetary biological signatures that indicate the existence of the biological compounds associated with life. We could then construct a probability based on stochastic processes that the necessary biological compounds randomly assemble into a biological lifeform during some period. Such a probability would be exceptionally small but could nevertheless be quantified in principle. On the contrary, we cannot eliminate the logical possibility that a hypothetical simulator – unconstrained by the bounds of our universe – could produce a simulation whose inhabitants are, due to explicit lines of code, incapable of acquiring credible and relevant information upon which to quantify the probability they are simulated. As such, the inhabitants of the simulation could only quantify a probability that they are simulated if they assume the hypothetical simulator did not produce this type of simulation. Thus, the inhabitants would need to assume a logical path exists to the simulator so that they could deduce this constraint upon the simulator's capabilities, in which case they assume the simulator exists and obviate the need for probability. On the contrary, one can assume biological compounds exist without addressing the question of whether extraterrestrial lifeforms exist. In this sense, our argument appears to uniquely concern propositions involving the existence of subjects outside the bounds of our universe, such as a hypothetical simulator.

III. Conclusion

We have argued that no nontrivial probability can be formulated regarding the proposition that we are simulated. Moreover, we have not challenged simulation theory as a concept. We have argued there is no room for partial belief between the binary of either assuming we do or do not inhabit a simulation.

References

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