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Uncertainty and limits of prediction

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1. Complexity is the significant property of the modern world and of the knowledge about it.

2. There are two kinds of complexity – quantitative and qualitative. The first relates to "big" systems; the second relates to the properties of connections between the elements of the system. These are ontological features of determinism.

3. Connections in the world relate to determinism as an ontological characteristic of our world. Determinism is the philosophical and general scientific conception, according to which the world is dominated by order and law as opposed to disorder and chaos. For a long time, the scientific picture of the world was dominated by determinism in a certain form. And this form was developed by the famous French mathematician Pierre Laplace.

4. According to such determinism, let us suppose we know the initial and boundary conditions of some object. In such case, the laws of nature allow us to predict and calculate the future or past behavior of the observed object without limitation and with maximum accuracy.

5. After hundred years long, another brilliant French mathematician, Henri Poincaré, developed Laplacian celestial mechanics. He investigated the future behavior of the solar system. Poincaré proved that in the far future there would be unstabilities in the motion of the planets. These unstabilities can lead to the appearance of limits of the prediction of the motion. So, the appearance of prediction of limits contradicts Laplacian determinism. Such situations are studied in a modern branch of mechanics called ‘nonlinear dynamics’.

6. At the beginning of the twentieth century quantum mechanics, with its famous Heisenberg uncertainty principle, made another serious impact to Laplacian determinism.

Here we are remembering the words of the famous Nobel laureate Ilya Prigozhin that we study our universe more and more, but understand it less and less.

7. There is a popular and, in my opinion, mistaken point of view, according to which uncertainty is a danger and should be eliminated.

However, what I said before shows that uncertainty is an objective property of complex unstable dynamical systems. In other words, uncertainty is not to be afraid of; it should be accounted in our research and calculations.