Since antiquity, philosophers and physicists have tried to describe the forces that govern matter. It has been found that electrostatic, magnetic and weak forces act on the particles. In the 1960s, these three forces have been described by one theory of electroweak interactions by Steven Weinberg, Sheldon Lee Glashow and Abdus Salam. The fourth interaction is responsible for the formation of nuclei and it is called the strong interaction.

In the 1920s it was discovered that at very small distances of the order of one billionth of a meter, the classical description of the world fails. In the classical theory particle, or other object, follows a well-defined trajectory. Classical mechanics introduces equations that the trajectory must obey. In quantum mechanics instead of a fixed trajectory we are talking about the probability, or more precisely about the complex amplitude that particle passes from one point to another. All the possible trajectories with appropriate weight give the contribution to the transition amplitude, not only this classical one.

For the electroweak and strong interactions we know the corresponding quantum theories, respectively: the theory of electroweak interactions and quantum chromodynamics. However, there is one force, which everyday experiences each of us - gravity. So far this force successfully escapes quantum description.

Each of us can easily conclude that we live in three-dimensional space. The position of each point can be clearly defined using three numbers - length, width and depth. In 1905, Einstein created the special theory of relativity, which within one theory treats time as a fourth dimension - from then we use a concept of four-dimensional spacetime. Special Theory of Relativity allowed to remove contradictions between classical mechanics and electrodynamics, consequently leading to the formulation of new, more fundamental theory.

In the following years, Einstein formulated the General Theory of Relativity. This is a classic theory of gravity, which has been thoroughly verified in many experiments. The General Theory of Relativity says that gravity is encoded in four-dimensional spacetime geometry and spacetume curvature tells about the existence of gravitational field.

The theory of gravity is distinguished from other theories, the main actor here is the spacetime, which in other theories is only a fixed/constant background. Instead the particle trajectory we have a four-dimensional geometry that connects the initial and final three-dimensional geometries.

To calculate the transition amplitude between these states, we have to add up the amplitudes of all possible geometries. This is of course very difficult. With the help comes the model of Causal Dynamic Triangulation. Instead of considering all smooth four-dimensional geometries, we are going to build them from a very small building blocks like Lego constructions.

Although the blocks themselves are three-dimensional cuboids, we can build with them objects with completely different geometrical characteristics.
The building blocks used by scientists, are however slightly different than Lego blocks. One can think of them as four-dimensional "triangles". Here, we are not limited number of blocks. When we put one block on the other we get a one-dimensional line, with the same blocks, we can also build any two-dimensional surface or three-dimensional shape. We can also construct an object that will not resemble any of the above-mentioned structures, neither a one-dimensional line, or two-dimensional surface or three-dimensional shapes. It may be, for example full of branches.

Because in the world there is too little Lego bricks, all of these operations of creating objects and summing up happen on your computer. Scientists create programs to simulate space. Of course, there are infinitely many ways to connect blocks but with the help of computers we can obtain the approximate result, so that, based on which, the researchers can draw conclusions about the structure and rules of the universe, and most importantly, they may find the answer to the question: how does a quantum description of gravity look like?

So far our construction was purely geometrical. This project addresses a question what will happen if we include matter to our structure.