What physical phenomenon is analyzed in this lecture? This lecture analyzes relativistic effects:

- according to special relativity theory, if an observer travels with a high speed, then for this observer, time slows down;
- according to general relativity theory, if an observer is located in an area with a strong gravitational field – e.g., near a black hole – then, for this observer, time slows down.

Explain the two main ideas of using relativistic effects to speed up computations. The first idea is for our civilization to start moving at a high speed as a whole, while the computers are left in a place that does not move. Then, our time will slow down. For example, if we slow down by a factor of 12, then 1 month of our time will be equivalent to 12 months (1 year) for everyone who is not moving. So, our computer will still require the same 1 year to solve a problem, but for us, the result will be ready in 1 month – i.e., 12 times faster.

The second idea is that we place our whole civilization in an area with a strong gravitational field – e.g., near the black hole – while leaving the computer outside. Then, similarly, our time will slow down. So, if it slows down by a factor of 12, our computer will still require the same 1 year to solve a problem, but for us, the result will be ready in 1 month – i.e., 12 times faster.

What speed-up can we achieve this way? Whatever we could compute in time $T$, we can now compute in much shorter time $\sqrt{T}$.

What can we conclude, from this lecture, about the main topic of this class: that by using some physical processes, we can go beyond the ability of the existing computers? By using relativistic effects, we can speed up computations.