Data is often called as a gold of XXI century. Therefore, it shouldn't be a surprise that in recent years many alternative computing methods are developed, including those that in principle mimics the behaviour of the neurons and neural networks.

The computing methods based on neural networks have been known for over 50 year, yet only recently they have gained enormous interest due to the development of advanced algorithms and increase in the today's electronic systems' computing power. Despite that this power is still sufficient for even highly complicated tasks, such as speech or image recognition, transistors – the building blocks of almost all silicon electronics circuits – operate with the logic that is completely different from the logic utilized by biological neurons. As transistors use only binary logic with two distinct states, the communication between neurons rely on many-valued and fuzzy logic. However, there exists an electronic element which can emulate the behaviour of the neurons – a memristor.

The memristor was first described in the 70s, but the first experimental realization was presented in 2008. The memristor, along with the resistor, capacitor and inductor, is included in the group of the basic passive electrical elements. To its characteristics, one can include pinched hysteresis loop observed in the current-voltage scans, which originates from the resistive switching. The presence of this effect results in that memristor exhibits behaviour analogous to biological neurons, such as learning, forgetting, synaptic plasticity and metaplasticity.

The latest researches show that in some memristive materials the resistive switching might be modulated with the light. Hybrid lead iodide perovskites can be given as an example. The migration of iodine vacancies and subsequent formation of conducting filaments is considered as the most probable resistive switching mechanism in these materials. The activation energy of iodine vacancies can be increased with illumination, which hinders the formation of the filaments and therefore enables the optical modulation of the resistive switching. We hypothesize, that this effect might be present in bismuth halide-based materials as well.

The aim of this project is to construct hybrid memristive devices with optically modulated resistive switching mechanism. For this purpose, the photoactive charge-trapping heptazine derivatives will be incorporated into the memristive layers of methylammonium bismuth halides. These devices will be incorporated into simple neural networks for signal processing and neuromorphic computing.