Memristor-based circuits and Architectures

In 1971, Prof. Leon Chua conceived only from symmetry reasons the possible existence of a new electronic component – the 'memristor'. This device is considered as the fourth fundamental element, in addition to the resistor, capacitor, and inductor. The name memristor indicates that it is a "resistor with memory." A memristor is basically a resistor with varying resistance, changes according to the total electric charge passed through it.

This mysterious device was only a theory until 2008. In 2008, Hewlett Packard Laboratories announced the success of fabricating a working memristor, based on oxides. After this announcement, additional memristors, based on different materials and technologies, were "discovered." Currently, most of emerging memory technologies, which are potential replacements for existing memory technologies, can be considered as memristors.

In this talk, the characteristics and behavior of memristors is described. It is shown how memristors can change the modern computer industry. Memristors can be more than just memory devices, and may be used for both storage and computation. I will present processors that use memristors to perform logic operations and to store more data than conventional memory. I will also describe neural networks that mimic the human brain, where memristors are used as synapses to connect neurons.