EE 129 (3 Units)

Neural & Nonlinear Information Processing

Spring 2009
Tuesday & Thursday
9:30 – 11:00 AM
299 Cory
(maximum enrollment : 25)

Instructor : Professor Leon O. Chua

This course is designed for senior and graduate students interested in Neural Networks, chaos, and Cellular Automata, including an in-depth analysis of Wolfram’s monumental book on: “A New Kind of Science”. The emphasis will be on the principles and applications of nonlinear dynamics and attractor-based computation to massively parallel real-time information processing, including the architecture and design of a CNN (Cellular Neural Network) Universal Machine, a real-time stored-program tera($10^{12}$) instructions per second supercomputer on a chip. Many real-world applications (e.g., artificial vision, dynamic associative memory, video compression, mammogram diagnosis, image fusion, motion and pattern recognition, missile detection and tracking, etc.) will be presented, along with demonstrations of the CNN universal chip, a brain-like computer on a chip. Other applications to be covered include the modeling of complex biological phenomena and higher brain functions. The universal Turing machine characterization of the CNN and a new principle called local activity will be used to present a unified principle of complexity and emergence, including self organization, morphogenesis, nonlinear waves, self replication and artificial life.

In view of the multidisciplinary nature of this course, all prerequisites beyond elementary physics and mathematics will be provided to make it self-contained and accessible also to students from biology, chemistry, mathematics, physics, etc.