Neural connections in the human brain are known to be modified by experiences. Yet, little is known about the mechanism of the modification and its implications on the brain function. The aim of this thesis is to investigate what impact the spatial properties of brain tissue can have on learning and memory. In particular, we focus on the dendritic plasticity. We present a model where the tissue is represented by a two-dimensional grid and its structure is characterized by various connections between the grid cells. We provide a formal definition of the model and we prove it to be computational as strong as the Turing machine. An adaptation algorithm proposed enables the model to reflect the environmental feedback, while evolutionary algorithms are employed to search for a satisfactory architecture of the model. Implementation is provided and several experiments are driven to demonstrate the key properties of the model.