

Lecture 1

What is learning?

We can broadly define learning as a change in a system which produces some type of adaptive behavior.

This notion of adaptive behavior is important. It suggests that learning is more than simply 'change'. It is directed change.

But how should one go about the study of these learning processes.

One can consider the study of systems at the operational level. That is, one attempts to describe and understand the workings of a complex system by carefully describing and quantifying the operations that system performs. This operational approach can be applied not only to a methodology of study - one which is quite useful, but also to a conceptualization of a system.

An example of this in the field of learning is that of behaviorism which was founded by B.F. Skinner. The Skinnerian approach involved studying and explaining the production of all behavior in terms of reinforcement. This school of thought was established on the fundamental observation that behavior can be modified through the careful and selective delivery of reinforcement. It was believed that all behavior could be explained in terms of this selective administration of reinforcement. Of course, this was terribly convenient because it eliminated the need to truly understand the complex machinery which had evolved to presumably successfully guide the organism through life.

Another well known adherent to the behaviorist school of thought was Donald Hebb. His famous formulation of the process by which neural systems may acquire and retain information was an attempt to place into neural terms, the necessary requirements of the behaviorists notion of reinforced behavior. That is that a neuron which has its input or stimulus paired with an output or response, will strengthen the connection of that input, thus increasing the likelihood of producing the response given the stimulus. This logical application of the behaviorist notions to the very substrate of behavior - the nervous system - has been extremely influential. Modern physiologists have sought to verify the existence of the so-called Hebbian synapse as a fundamental building block in the learning and memory process.

But how do these paradigms for studying learning translate to complex behavior. Are there different types of learning? Are they handled by different structures and processes within an organism? Are there different computations underlying these processes? And how does this collection of phenomena which we can collectively discuss under the umbrella of 'learning' combine to describe the complex adaptive behavior of an organism.

In this course we will attempt to explore some of these questions. Along the way we will examine the contributions that have been made by biologists exploring the properties of specific biological systems. We will study the properties of cells and brain structures in an effort to forge a picture of the brain not as a mysterious black box but as an organized collection of structures designed to achieve the goal of 'adaptive behavior'.