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## Neural Networks Module

The module below can be covered in a three week period in the Introduction to AI Course

- Brief History of Neural Networks
- Definition of a Neural Network
- Learning in a Neural Network
- The Pattern Associator
- The Hebb Rule
- The Delta Rule
- The Generalized Delta Rule

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## The Hebb Rule

The Hebb rule determines the change in the weight connection from  $u_i$  to  $u_j$  by  $\Delta w_{ij} = r * a_i * a_j$ , where  $r$  is the learning rate and  $a_i$ ,  $a_j$  represent the activations of  $u_i$  and  $u_j$  respectively. Thus, if both  $u_i$  and  $u_j$  are activated the weight of the connection from  $u_i$  to  $u_j$  should be increased.

Examples can be given of input/output associations which can be learned by a two-layer Hebb rule pattern associator. In fact, it can be proved that if the set of input patterns used in training are mutually orthogonal, the association can be learned by a two-layer pattern associator using Hebbian learning. However, if the set of input patterns are not mutually orthogonal, interference may occur and the network may not be able to learn associations. This limitation of Hebbian learning can be overcome by using the delta rule.

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