The Inherent Capacity of Neurons to Learn Order Relations and Support Abstract Reasoning: A Theoretical Foundation for Key Features of Intelligence

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Rank Learning Rule. If information is received that $\mathbf{a}_i \prec \mathbf{a}_j$ for some items $\mathbf{a}_i$ and $\mathbf{a}_j$, but $\mathbf{wa}_j$ is not by some given margin δ larger than $\mathbf{wa}_i$, one updates $\mathbf{w}$ by adding a fraction η of $\mathbf{a}_j$ and subtracting a fraction η of $\mathbf{a}_i$:

$$\mathbf{w} \leftarrow \mathbf{w} + \eta \left(\mathbf{a}_j - \mathbf{a}_i \right). \tag{1}$$

2D projections of our model / brain data

F MDS after train short
G MDS after train long
H RDM after train short
I RDM after train long